Service Manual

M4735A HeartStart XL
Defibrillator/Monitor

PHILIPS

Notice

About This Edition

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Use of supplies or accessories other than those recommended by Philips Medical Systems may compromise product performance.

Warning

Radio Frequency (RF) interference from nearby transmitting devices may seriously degrade performance of the M4735A HeartStart XL Defibrillator/Monitor. Electromagnetic compatibility with surrounding devices should be assessed prior to using the defibrillator.

THIS PRODUCT IS NOT INTENDED FOR HOME USE.
IN THE U.S., FEDERAL LAW RESTRICTS THIS DEVICE TO SALE ON OR BY THE ORDER OF A PHYSICIAN.

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Medical Device Directive

The M4735A Defibrillator/Monitor complies with the requirements of the Medical Device Directive 93/42/EEC and carries the CE 0123 mark accordingly.

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This manual uses the following text conventions:

Printed and On-Line

WARNING	**Warning statements describe conditions or actions that can result in personal injury or loss of life.**
CAUTION	Caution statements describe conditions or actions that can result in damage to the equipment or loss of data.
NOTE	Notes contain additional information on servicing this product.

TIP:

Tips provide hands-on insight into servicing this product.

Text	represents messages that appear on the display
Softkey	represents softkey labels that appear on the display above or below the button to which they correspond

On-Line Only

Hypertext	represents hypertext links, which will display as blue; click on the link to go to that destination, then click on the destination to return.

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1 Introduction

Who Should Use this Manual

This Service Manual provides the information needed to successfully service the M4735A HeartStart XL Defibrillator/Monitor. The intended users of this manual are technical personnel who have been trained in the safe and proper servicing of the M4735A.

Overview

In this chapter, you'll find general information that you should become familiar with before servicing the M4735A. Detailed information regarding controls, operation, and capabilities of the instrument can be found in the ***Instructions for Use*** (M4735-91900) that was shipped with the product.

We recommend you review the ***Instructions for Use*** before servicing this device. This Service Manual assumes you are familiar with the controls and with basic operations.

For additional documentation on the HeartStart XL, visit our web site at:

www.medical.philips.com/goto/productdocumentation

Web-Based Training

Web-based service training for the M4735A HeartStart XL Defibrillator/Monitor is available. You can access the training through the InCenter web site at incenter.medical.philips.com. Contact your Philips representative to get access to the InCenter web site.

Defibrillator/Monitor

The M4735A is a biphasic, semi-automated external defibrillator. This portable, lightweight device offers two modes of operation for defibrillation:

- Semi-Automatic External Defibrillation (AED) Mode
- Manual Mode

In AED Mode, the M4735A analyzes the patient's ECG and advises the clinician whether or not to deliver a shock. Defibrillation is performed through multifunction defib electrode pads.

In Manual Mode, the M4735A turns control of the defibrillation process over to the clinician. The clinician analyzes the patient's ECG, decides if defibrillation is advised, and determines the energy setting for defibrillation. Defibrillation is performed either through multifunction defib electrode pads or through paddles.

Manual Mode also allows the clinician to perform synchronized cardioversion and offers optional noninvasive pacing (using a monophasic waveform).

ECG monitoring can be accomplished in either mode using one of 3 methods:

- ECG from the defib pads.
- 3-lead ECG using separate monitoring electrodes.
- Optional 5-lead ECG using separate monitoring electrodes.

Optional pulse oximetry (SpO_2) monitoring is available in both modes, as well.

The M4735A automatically stores critical events, such as shocks and alarm violations, in its internal memory. An Event Summary may be printed at any time. The M4735A also enables you to store data and events on an optional HeartStart XL-compatible Data Card (see Chapter 5 for a listing) for down-loading to the Event Review Data Management System.

Batteries

The M4735A is powered by a rechargeable Sealed Lead Acid (SLA) battery (M3516A). Proper care of these batteries will ensure that they have the energy required to operate the M4735A and deliver the appropriate therapy. For more details see the "Battery Maintenance" section in the ***Instructions for Use***, and the ***Battery Maintenance Application Note***.

NOTE

The defibrillator will take longer to charge when powered by AC without a battery installed. To ensure optimal performance, always have a fully charged battery in the defibrillator, even when using AC power.

Installation

The M4735A does not require installation. The ***Instructions for Use*** describes the setup required before placing the device into service, as well as configuration options.

Upgrades

Upgrades are available to add specific functionality to units in the field. These upgrades are:

- M4738A Pacing Upgrade (adds pacing).
- M4739A SpO_2 upgrade. (adds SpO_2).

Consult your sales representative or dealer or distributor for the latest details.

Preventive Maintenance

Preventive maintenance and periodic operational checks are intended to be performed by the user. Both topics are covered in the Maintenance chapter of the ***Instructions for Use***.

Repair Philosophy

Defibrillator/Monitor

The repair philosophy of the M4735A is subassembly replacement. Examples of subassemblies are the printer, the Control Printed Circuit Assembly (PCA), and selected connectors and other items. Repairs that involve replacing components on a PCA are ***not*** supported.

CAUTION

Individual component replacement should *not* be attempted outside of a factory authorized repair facility. Component level repair is extremely difficult due to the extensive use of surface mount technology and the high parts-density on the circuit boards. Unauthorized component replacement can impair performance of the M4735A.

Batteries

The repair philosophy for the SLA battery (M3516A) is unit replacement. If a battery fails, it is replaced, not repaired.

For information on ordering replacements, see "Supplies & Accessories" on page 5-18.

2 Performance Verification and Safety Tests

Overview

This chapter describes the tests and inspections required to verify performance of the M4735A Portable Defibrillator/Monitor.

Chapter Contents

The major sections of this chapter are as follows:

Required Testing Levels

The Performance Verification Tests in this chapter are intended to verify proper operation of the M4735A following repair. The level of testing required corresponds to the type of repair performed, and is divided into 3 categories:

- **External Repairs/No Trouble Found.**
- **Printer Replacement.**
- **Internal Repairs.**

External Repairs/No Trouble Found

External Repairs are those involving the repair or replacement of one or more of the items below. **No Trouble Found** applies when no malfunction can be found, or when the problem appears to be due to improper use. In either situation, the key point is that ***the case has not been opened.***

- External paddles
- Internal paddles and/or adapter cable
- Paddle holders
- Pads adapter cable
- ECG cable
- SpO_2 cable or sensor
- Battery
- Labels
- AC Power cord
- Consumables (ECG monitoring electrodes, multifunction defibrillation pads, printer paper)
- Main fuse (on Battery PCA)
- Data Card Door Assembly
- Battery Eject Assembly

The following testing is required after an **External Repair** or when the outcome of the service is **No Trouble Found** ***(when the case has not been opened)***:

- Perform the Visual Inspection (page 2-15).
- Run the Extended Self Test (page 2-24).
- Print and Verify the System Log (page 2-22).

Printer

If the printer was replaced, ***and the case was not opened,*** the following tests are required:

- Perform the Visual Inspection (page 2-15).
- Run the Extended Self Test (page 2-24).
- Run the Printer Test (page 2-29).
- Print and Verify the System Log (page 2-22).

Internal Repairs

If the case was opened (regardless of what the repair involved), all of the Performance Verification Tests must be performed, beginning with "Visual Inspection" on page 2-15.

Test and Inspection Matrix

Table 2-1 summarizes performance verification tests and inspections for the M4735A; including test name, test or inspection to perform, expected test results, and data to record.

Table 2-1 Performance Verification and Safety Tests

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
Visual Inspection (V)	**Inspect the unit, accessories, cables, etc.for signs of wear, damage, corrosion, or missing items, as described on page 2-15.**	If no unusual damage, no corrosion, no missing items: x=p. *then Visual Inspection passes*	V:x *Example V:p*
Functional Checks (F)	In normal Operating Mode, perform the following functional checks: • ECG (page 2-17). • Shock Advisory (page 2-18). • Synchronized Cardioversion (page 2-19). • SpO_2 (page 2-20).	If all functions respond as expected: x=p • Waveform clear on display; HR correct on display; HR alarm works. Leads off, pads off indicators as expected. • Shock Advised only when appropriate • Shock delivered with correct timing (≤60msec) • 95% -100% *then Functional Check passes*	F:x Example F:p
Extended Self Test (X)	**In Diagnostic Mode, run the Extended Self Test (page 2-24). Includes Data Card Test and time/date check.**	If "Pass" reported on all tests applicable to the device configuration and options: x=p. *then Extended Self test passes*	X:x *Example X:p*

Table 2-1 Performance Verification and Safety Tests *(Continued)*

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
User Interface Tests (U)	**• In Diagnostic Mode, run the following tests (page 2-27):** • Controls Test • Display Test • Audio Test • Printer Test	If all data within limits, all checks pass: x=p • All keys respond as expected • Visual Pass assessment by service personnel • Alerts, alarms, and tones are clearly heard • Print quality is adequate; no stray marks or lines. • Print speed: 25 mm ± 5% (1.25mm) *then User Interface test passes*	U:x *Example: U:p*
ECG Tests (E)	**In Diagnostic Mode, run the ECG Tests (page 2-32):** • Status messages (lead, pad, DSP) • DC offset ***Amplifier gain*** • Pads Peak to Peak (Monitor) • Leads Peak to Peak (Diagnostic) ***Amplifier noise*** • Leads Peak to Peak (Diagnostic) - cc • Pads Peak to Peak (Monitor) - dd ***PCI measurement*** • PCI - Paddles in Pockets • PCI - Paddles open	If all data within limits, all checks pass: x=p • "Good" displayed for all three status messages • Ignore DC Offset - used only in factory manufacturing. • 1000uV ±10% • 1000uV ±10% • 0 ± 30uV • 0 ± 30uV • 50 ± 30 Ω • ≥ 1250 Ω *then ECG Test passes*	E: x *Example: E:p*
Pacing Test (P)	**In Diagnostic Mode, run the Pacing Test (page 2-37):** • (70 ppm) 30 mA • (180 ppm) 200mA	All data within limits, all checks pass: x=p • 30 mA ± 5 mA • 200mA± 20 mA	P:x *Example: P:p*

Table 2-1 Performance Verification and Safety Tests *(Continued)*

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
Defibrillator Test - AC Power (DA) (if AC Power used in normal operation)	**Using only AC power, enter Diagnostic Mode and run the Defibrillator Test (AC Power at 200Joules) (page 2-39):** ***Measured by Defibrillator Analyzer:*** • Delivered energy ***Displayed by M4735A:*** • Available Energy after Shock • Msec to charge • Delivered energy • Impedance • Defib errors	All data within limits, all checks pass: x=p. If the measurements are as follows: • 200 ± 30J • 0 • ≤ 15000 msec • Actual delivered energy ±7% • 42 to 57 Ω • None (0) *then the Defibrillator test (AC Power) passes*	DA:x *Example: DA:p*
Defibrillator Test - Battery Power (DB)	**Using only battery power, enter Diagnostic Mode and run the Defibrillator Test (at 200Joules) (page 2-40).** ***Measured by Defibrillator Analyzer*** • Delivered energy ***Displayed by M4735A*** • Available Energy after Shock • Msec to charge • Delivered energy • Impedance • Defib errors	All data within limits, all checks pass: x=p If the measurements are: • 200 ± 30 J • 0 • ≤ 3000 msec • Actual delivered energy ±7% • 42 to 57 Ω • None (0) *then the Defibrillator test (Battery Power) passes*	DB:x *Example: DB:p*
Defibrillator Disarm Test (D)	**Enter Diagnostic Mode and run the Defibrillator Disarm Test (page** 2-41)	All readings as expected: x=p. No errors reported. *then the Defibrillator Disarm test passes*	D:x *Example: D:p*

Table 2-1 Performance Verification and Safety Tests *(Continued)*

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
Safety Tests	**Indicate test results as follows:**	Note: All leakage current tests include both Normal and Reverse Polarity Conditions. Report worst case values. All values within limits: x=p	
Earth Leakage Current (S1)	Earth Leakage Current NC (Normal Condition) - aaa	If Normal Condition Maximum leakage current • < 300 uA (UL, 120 VAC) • ≤ 500 uA (IEC, 240 VAC)	S1:P/aaa/bbbb *Example:* *S1:P/125/800*
	Earth Leakage Current SF (Single Fault -open neutral) - bbbb	If Single Fault Maximum leakage current • ≤ 1000 uA *then Earth Leakage Safety test passes*	
Patient Lead Leakage (S3)	***ECG Patient Cable***	If readings are as expected:	S3:P/aa/bb/cc/dd/ee/ff/ggg/hhh/iii/jj/kk/lll *Example:* *S3:P/9/49/49/10/50/50/100/499/4750/9/49/83*
	• Source (Normal Condition) - aa	≤ 10 uA	
	• Source (Single Fault condition - open earth, open neutral) - bb	≤ 50 uA	
	• With Mains on applied part (Single Fault condition) - cc	≤ 50 uA *then Patient Lead Leakage Safety test passes*	
	SPO_2	If readings are as expected:	
	• Source (Normal Condition) - dd	≤ 10 uA	
	• Source (Single Fault Condition - open earth, open neutral) - ee	≤ 50 uA	
	• With Mains on applied part (Single Fault condition) - ff	≤ 50 uA *then Patient SPO_2 Leakage Safety test passes*	

Table 2-1 Performance Verification and Safety Tests *(Continued)*

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
	External Paddles/Pads • Source (Normal Condition) - ggg • Source (Single Fault Condition) - hhh • With Mains on applied part (Single Fault Condition) - iii	If readings are as expected: ≤ 100 uA ≤ 500 uA ≤ 5000 uA *then External Paddles/Pads Safety test passes*	
	Internal Paddles • Source (Normal Condition) - jj • Source (Single Fault Condition) - kk • With Mains on applied part (Single Fault Condition) - lll	If readings are as expected: ≤ 10 uA ≤ 50 uA ≤ 100 uA *then Internal Paddles/Pads Safety test passes*	

Note: When recording test results, separate results within a test by slashes; separate tests by a semicolon (;); and use no empty spaces. For example:

V:x;F:x;X:x;U:x;E:x;P:x;
DA:x;DB:x;D:x;
S1:P/aaa/bbbb;S3:P/aa/bb/cc/dd/ee/ff/ggg/hhh/iii/jj/kk/lll

V:p;F:p;X:p;U:p;E:p;P:p;
DA:p;DB:p;D:p;
S1:P/125/800; S3:P/9/49/49/10/50/50/100/499/4750/9/49/83

Test Equipment

Table 2-2 lists the equipment needed to perform the Performance Verification tests, and provides specifications for commercially available analyzers and simulators. Test equipment is called out within each test procedure when needed. In addition, A 50 ohm test load is available (M1781A or M3725A).

Table 2-2 Equipment List

Equipment/Test	Specifications
ECG Simulator	
Calibrated Leads ECG simulator	
• Amplitude accuracy	±2%
• Rate accuracy	±2%
Calibrated Paddles ECG simulator	
• Amplitude accuracy	±2%
• Rate accuracy	±2%
Defibrillator Analyzer	
Waveform compatibility	Meets all specs below using biphasic truncated exponential waveform.
Load resistance:	50 Ω ±1% (non-inductive)
Maximum energy:	≥ 200 joules
Maximum voltage:	≥ 2500 V
Maximum current:	≥50 A
Measurement accuracy:	
• ≥ 20 joules:	≤ ±2% of reading
• < 20 joules:	≤ ±0.4 joules
Cardioversion measurement range:	–150 to +150 ms
Pacer tester	
Load impedance:	≤400 Ω
Current measurement accuracy	
• 10 mA–50 mA:	<±2 mA
• 50 mA–200 mA:	<±4%
Rate measurement accuracy	
• 30–180 ppm:	<±0.5%
Waveform duration accuracy:	
• 30–180 ppm:	±1ms

Configuration and Diagnostic Modes

The instructions below describe how to enter Configuration Mode and Diagnostic Mode.

Configuration Mode

These instructions describe briefly how to use Configuration Mode. See the ***Instructions for Use*** for details on configuration settings and what effect they have.

CAUTION

Inserting or removing the Data Card while the unit is on can corrupt the Data Card and prevent the unit from powering on again. If this occurs, see Chapter 3, Troubleshooting.

1. **Power off.**

   Make sure the unit's power is off.

2. **Insert a Data Card (if applicable).**

   If you intend to save the configuration to a Data Card (or load the configuration from a Data Card), insert the Data Card now. To avoid possible confusion, designate one Data Card as the "Configuration Card" and label it clearly. Keep this card physically separate from cards used by the clinical staff for data storage.

3. **Enter Configuration Mode.**

   Press softkeys 4 and 5 at the same time, and hold them down while turning the power on. See Figure 2-1 for softkey numbering.

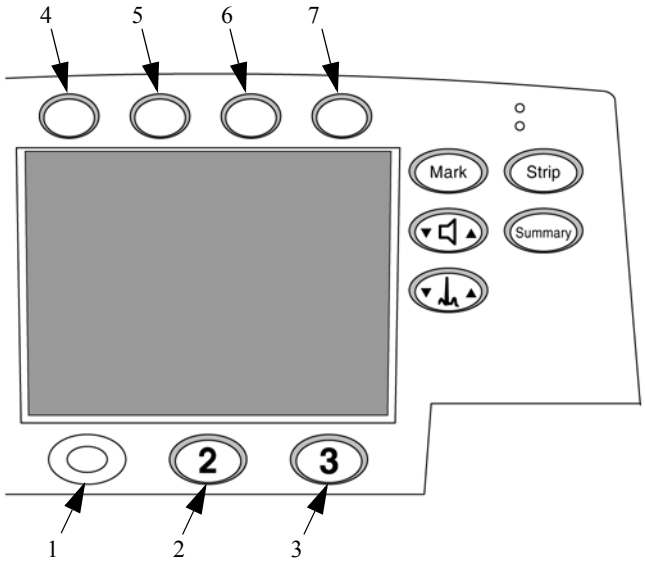
4. **Select and manage Configuration choices.**

   - To select a configuration, press the ▲ and ▼ softkeys to move up or down the list until the desired **Settings** item is highlighted. Then press the ENTER softkey to access those settings.
   - To print out a strip with all the current configuration choices, select **Print All Settings** and press ENTER.
   - To store the configuration settings on a Data Card, select **Save Settings to Data Card** and press ENTER. When prompted with **Save Settings to Data Card?** press SAVE.
   - To load configuration settings from a Data Card, select **Load Settings from Data Card** and press ENTER. When prompted with **Load Settings from Data Card?** press LOAD.

5. **Exit Configuration Mode.**

   - To exit Configuration Mode, turn the unit off.
   - Wait 2 seconds. Remove the Data Card by pressing the black eject button and pulling the Data Card from the compartment.

Figure 2-1 Softkey Numbers



Diagnostic Mode

These instructions describe how to enter Diagnostic Mode. Once in Diagnostic Mode, you can do the following:

- Print the System Log. See "System Log" on page 2-22.
- Run the Extended Self Test. See "Extended Self Test" on page 2-24.
- Run other Diagnostic Tests. See "Diagnostic Tests" on page 2-21.

1. **Power off.**

   Make sure the unit's power is off.

2. **Enter Diagnostic Mode.**

   Press softkeys 4 and 6 at the same time, and hold them down while turning the Energy Select Switch to **Manual On**. (See Figure 2-1 for softkey numbering.)

3. **Wait for the unit to initialize.**

   This may take several seconds. The unit is ready to proceed when the screen cursor responds to softkey inputs.

4. **Select the desired test or function.**

   To select a test, press the ▲ and ▼ softkeys to move up or down the list until the desired test is highlighted. Then press the ENTER softkey to start that test.

5. **Exit Diagnostic Mode.**

   To exit Diagnostic Mode, turn the unit off.

The Language Support Tool

The Language Support Tool allows field service personnel to perform several tasks:1) to set the language of the Control PCA of the defibrillator; 2) to enable the SpO_2 option; 3) to program in the serial number. These tasks need to be performed under the following circumstances:

- The Control PCA has been replaced.

  The Control PCA contains all the operating software, configured for the installed hardware. It also contains the unit's serial number, which was assigned and programmed during manufacturing.

  The new Control PCA must be programmed to recognize the hardware installed in this unit, to contain that unit's serial number, and to set the language of the unit.

- The unit has received an upgrade adding the SpO_2 capability.

  The added hardware will ***not*** be automatically recognized. The Control PCA must be programmed to recognize the new hardware installed.

- The unit's software is being updated.

  Software upgrades are periodically released to resolve customer issues. The Language Support tool enables you to load new software onto the unit.

Using the Language Support Tool

1. **Save the configuration to a Data Card.**

   a. Make sure the unit is powered off, and have either a fresh battery installed or the AC power cord plugged in.

   b. Follow the instructions in "Configuration Mode" on page 2-10 to save the configuration to a Data Card.

2. **Activate the Language Support Tool**

   a. Insert the Language Support Tool data card into the unit.

   b. Press softkey 7 and **Mark** at the same time, and hold them down while turning the Energy Select Switch to **Manual On**. (See Figure 2-1 for softkey numbering.)

3. **Follow the screen prompts.**

   a. Press **YES** to continue.
   The message "Upgrade software found Proceed to Program?" is displayed.

   b. Press **Yes** to set the unit's language. Do ***not*** press any keys or touch the unit until the process is complete.

   c. Select whether SpO_2 hardware is installed or not as appropriate.

   d. Program in the unit's serial number.

   - If this is an SpO_2 upgrade, the serial number should already be present. In this case, verify it against the factory-applied label on the bottom of the case.
   - If this is a Control PCA replacement, program in the serial number found on the factory-applied label on the bottom of the case using the softkeys as instructed on the screen. Be sure to program it in accurately, as the serial number is used for all repair history tracking.

   e. Check all the displayed information carefully before proceeding.

   - If the displayed information is correct, follow the screen prompts to save the configuration.
   - If any of the information is incorrect, follow the prompts to NOT save the configuration, then start over by powering the unit off, then back on.

4. **Turn off the power. Wait 2 seconds. Remove the Data Card by pressing the black eject button and pulling the card from the compartment.**

5. **Check the customer configuration.**

   a. Turn the unit back on and enter Configuration Mode (see "Configuration Mode" on page 2-10).

   b. Print the configuration and check it against the printout from before the servicing began. Reset the configuration (or load it from a Data Card) as needed.

6. **Verify performance.**

   Perform Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Performance Verification Tests

This section gives instructions for running Performance Verification tests on the M4735A. The tests are sequenced to check more basic functions first, and then build on that to check more complex functions. We recommend you perform these tests in this sequence. If desired, you can make copies of the Test Results Matrix (page 2-4) and use it to record results.

The Performance Verification tests include:

Visual Inspection

1. **Examine the cables, supplies and accessories.**

   a. **Are they the right ones?**

   Sometimes a problem can be resolved simply by using the cables and supplies with which the unit was designed to operate.

   - Are these the brands and models your institution purchases, or are they "strays" from somewhere else?
   - Are they Philips-approved, or are they some other brand?

   The unit should have:

   - An undamaged, fully charged M3516A battery.
   - A new, dry roll of Philips 40457C/D printer paper. Printer paper may jam if paper is wet. Also, printer may be damaged if wet paper is allowed to dry while in contact with the printhead elements.
   - Cables and sensors which are approved by Philips and known to be good. Also make sure that all external cables are fully inserted in their receptacles.
   - A new, empty HeartStart XL-compatible Data Card (see Chapter 5 for listing). Plugging in the wrong type of card (e.g., a modem card) can cause startup failures.

   b. **Are the consumables fresh?**

   Check the ECG electrodes and defibrillator pads for freshness (date code or expiration date) and condition.

Pass: Accessories and supplies are those specified by Philips. Electrodes and pads are within their expiration date and appear usable. Packaging is unopened and shows no tears or punctures. No corrosion is visible on connector sockets, electrodes, or pads.

2. **Examine the entire unit.**

   a. Inspect the unit on all sides, looking for:

   - Signs of mechanical damage to the case, membrane switches, speaker cover, display window, or printer.
   - Loose or missing hardware.
   - Evidence of liquid spill. Check inside the printer bucket and clean out any accumulation using gloves and an approved cleaner. Also check for residue in the connectors at the back of the unit (ECG, SpO_2, ECG Out/Sync).
   - Residue on the thermal printhead.
   - Damage to connector pins, or corrosion on the pins, or debris in the connector.

b. Inspect the paddles, power cord, battery, cables, and sensors for signs of the following:

- Wear or damage to paddles, cables, and adapters.
- Wear or damage to patient cables and associated strain reliefs.
- Printer roller wear.
- Wear or damage to power cord and associated strain relief.
- Corrosion on connector pins, printer parts, or battery contacts.

Pass: Only normal wear, no damage serious enough to inhibit performance. No corrosion visible.

Functional Checks

The functional checks below exercise the basic functions of the defibrillator/monitor. They are intended as a broad check of the unit's performance, and are designed to complement (not replace) the Diagnostic Tests described later.

If all elements of a test pass, record that test as a PASS and return to the main diagnostic menu by pressing MAIN. If there is any failure, begin troubleshooting and repairing as needed. See "Troubleshooting" on page 3-1.

ECG Functional Checks

This section describes how to check the operation of the ECG functions. Each of the ECG checks assumes the unit and the simulator are still set up as they were at the end of the previous ECG check.

To check ECG display and Heart Rate (HR) functions:

1. **Set up the simulator.**
   a. Connect the ECG simulator to both the Pads input and the 3- or 5-lead ECG cable.
   b. Set the simulator for normal sinus rhythm (NSR), 1mV amplitude, at some nominal rate (e.g., 60 bpm).
2. **Set up the M4735A.**
   Set the M4735A to Manual operating mode (not Diagnostic Mode).
3. **Check the displayed ECG.**
   Using the LEAD SELECT softkey, verify that the display shows a normal ECG with a clean baseline for both Pads and Lead II.
4. **Check the Heart Rate (HR).**
   Verify that the Heart Rate (HR) displayed is correct.
5. **Check Leads Off.**
   a. Disconnect the ECG simulator from the pads cable and verify that the display shows a dashed line in place of the waveform and that the unit both alarms and gives the **Pads Off** message
   b. If using a 3-lead cable, set the unit to monitor from Lead II. For a 5-lead ECG cable, set the unit to monitor from the V lead.
   c. Disconnect each of the ECG leads from the simulator one at a time, and verify that the display shows a dashed line in place of the waveform and that the unit both alarms and gives the **Leads Off** message.

To check ECG printing functions:

6. **Reconnect the simulator.**

   Connect the simulator to the M4735A as described in step 1 above.

7. **Print a strip.**

   a. Press **Strip** to print a strip.

   b. Verify that it shows a normal ECG with a clean baseline.

   c. Verify that the date, time, and configuration information printed at the top of the strip is correct.

   d. Press **Strip** again to stop printing.

Shock Advisory Functional Check

This section describes how to check the Shock Advisory function.

1. **Set up the simulator.**

   a. Connect the ECG simulator to the pads cable.

   b. Set the simulator for normal sinus rhythm (NSR), 1mV amplitude, at some nominal rate (e.g., 60 bpm).

2. **Set up the M4735A.**

   Set the M4735A to AED Mode.

3. **Check Shock Advisory with NSR.**

   a. Press ANALYZE.

   b. Verify that the defibrillator responds with **No Shock Advised**.

4. **Check Shock Advisory with Asystole.**

   a. Set the simulator to Asystole (or turn the simulator off) and press ANALYZE.

   b. Verify that the defibrillator still responds with **No Shock Advised**.

5. **Check Shock Advisory with VF.**

   a. Set the simulator to VF (Ventricular Fibrillation) and press ANALYZE.

   b. Verify that the defibrillator responds with **Shock Advised** and charges up to 150J. If the unit is configured to do so, verify that it automatically prints a strip of the event.

WARNING

Do not discharge the stored energy unless you are certain the simulator contains a 50 ohm test load.

   c. If the simulator contains a 50 ohm test load, discharge the stored energy into the test load. If it does not, or you are not sure, wait until the defibrillator reports **Shock cancelled** before proceeding.

Synchronized Cardioversion Functional Check

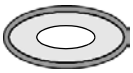
This section describes how to check the synchronized cardioversion function.

1. **Set up the simulator and the analyzer.**

   a. Connect the ECG simulator to the ECG cable. Connect the defibrillator analyzer to the pads cable.

   b. Set the simulator for normal sinus rhythm (NSR), 1mV amplitude, at some nominal rate (e.g., 60 bpm).

2. **Set up the M4735A.**

   Set the defibrillator to Manual Mode, and press  (**Sync On/Off**).

3. **Check Cardioversion.**

   a. Verify that sync markers appear on the display, at the peak or on the falling side of the QRS complex. Adjust the size of the displayed ECG as needed to view it more clearly.

   b. Select an energy of 5 J. Press CHARGE then press and hold SHOCK until the shock is delivered (at next QRS).

   c. Verify on the defibrillator analyzer that the shock was delivered, and was 5J ±2J.

   d. If the unit is configured to do so, verify that it prints a strip with the correct information on it (waveform, text).

   e. Verify on the defibrillator analyzer that the delay between the peak of the QRS and the delivered shock was ≤60 msec.

$Sp0_2$ Functional Check

This check only needs to be performed if SpO_2 is installed.

1. **Connect the sensor.**

   Attach the SpO_2 transducer to your finger and connect it to the M4735A.

2. **Check SpO_2.**

   a. Activate Manual Mode and press the SpO_2 softkey to turn SpO_2 on.

   b. The SpO_2 value displayed should be in the range of 95-100%. If the value is less than 95%, check that your finger is fully inserted into the sensor and properly positioned.

Diagnostic Tests

The M4735A includes an extensive set of Diagnostic Tests, which test the major hardware components of the defibrillator.

The Diagnostic Tests include:

System Log

The System Log includes the unit's serial number, hardware configuration, and a listing of error codes. The System Log should be printed each time a Performance Verification Test is run.

1. **Enter Diagnostic Mode.**

   See "Diagnostic Mode" on page 2-11.

2. **Print the System Log.**

   a. Select **Print Log** and press ENTER .

   b. The printer will print the System Log strip. See "Sample System Log Printout" on page 2-23.

3. **Check the System Log.**

   a. Check hardware and options.

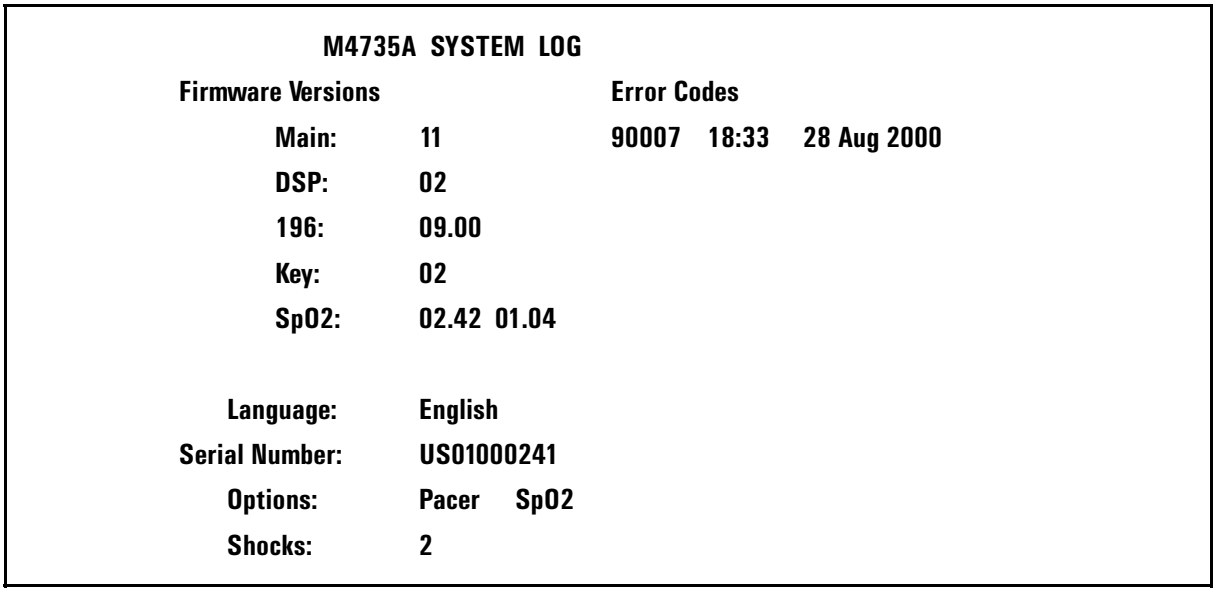
   - Check the printout to verify the printed results are consistent with the hardware in place. Check options installed (SpO_2, pacing) and the unit's serial number (on the bottom of the case).
   - If the printout is not correct, investigate and resolve the source of the mismatch. Then reset the hardware options and serial number as needed using the Language Support Tool. See "The Language Support Tool" on page 2-12.

   b. Check for M4735A errors.

   If there are device errors reported in the System Log:

   - Check the time and date stamps to see if they are recent errors.
   - Consult Table 3-2 "Error Codes" on page 3-11 to identify the errors.
   - Begin troubleshooting as needed (See "Troubleshooting" on page 3-1.)

Figure 2-2 Sample System Log Printout



M4735A SYSTEM LOG

Firmware Versions		Error Codes
Main:	11	90007 18:33 28 Aug 2000
DSP:	02	
196:	09.00	
Key:	02	
SpO2:	02.42 01.04	
Language:	English	
Serial Number:	US01000241	
Options:	Pacer SpO2	
Shocks:	2	

Extended Self Test

The Extended Self Test checks that all internal processors are operating and communicating with each other.

If all results are as described, the unit passes this test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1, and Table 3-6 "Extended Self Test Failures" on page 3-19.

NOTE

Be sure the printer has paper and that the printer door is closed. No paper or an open door will generate an erroneous **Fail** in the **Timebase** test.

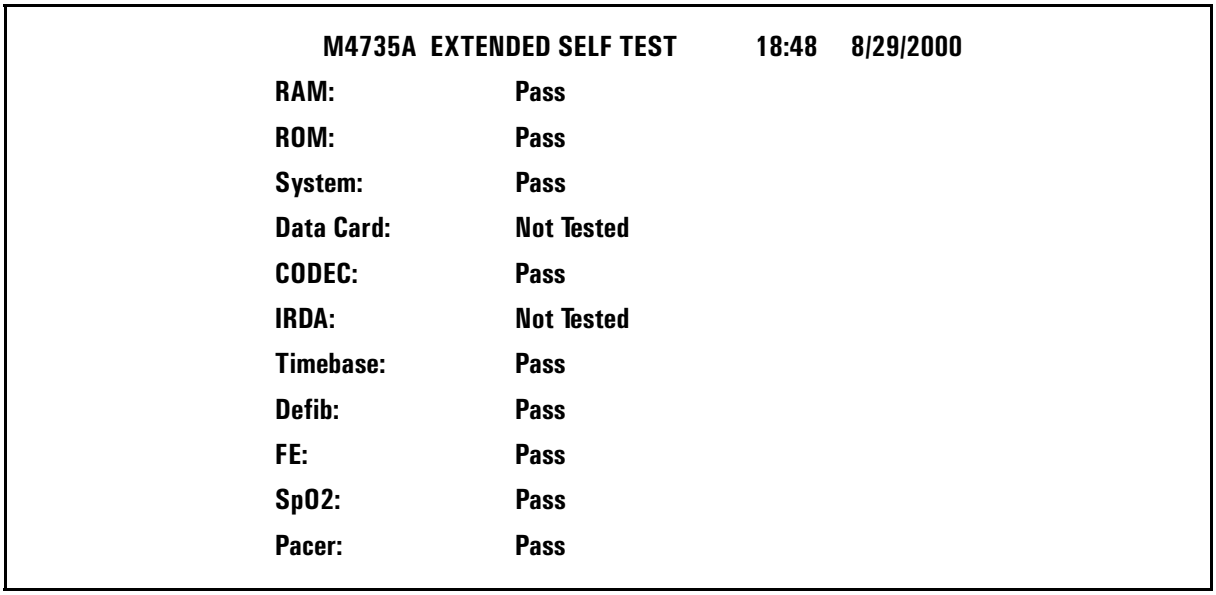
Make sure that no one touches the unit during the self test as that can generate an erroneous **Not Tested** or **Fail** message.

1. **Connect the test load to the pads cable.**
2. **Access the Diagnostic Test menu.**

   See "Diagnostic Mode" on page 2-11.
3. **Run the test.**

   Select **Extended Self Test** and press ENTER. The printout should appear similar to Figure 2-3.

Figure 2-3 Sample Extended Self Test Printout



M4735A EXTENDED SELF TEST 18:48 8/29/2000

RAM:	Pass
ROM:	Pass
System:	Pass
Data Card:	Not Tested
CODEC:	Pass
IRDA:	Not Tested
Timebase:	Pass
Defib:	Pass
FE:	Pass
SpO2:	Pass
Pacer:	Pass

4. **Check the results.**

   a. Check the time and date.

   - Check the printout to verify that the time and date are correct.
   - If they are not, reset them using the Configuration Mode. See "Configuration Mode" on page 2-10.

   b. Check the test results.

   The results of the following tests will appear on the display and on the printout:

   - **RAM**

     Tests the Random Access Memory (RAM).

   - **ROM**

     Tests the Read Only Memory (ROM).

   - **System**

     Tests the integrity of the core processing system and checks the Lithium backup battery.

- **Data Card**

  The Data Card test writes a small file to the Data Card, reads it back and checks it, then erases that file. If no Data Card is present, the test result will be **Not Tested**.

- **CODEC**

  The processor turns on the CODEC (coding/decoding) chip (used for voice prompts), and gets an acknowledgement that it's ready to receive data. It does not give the CODEC actual data to process.

- **IRDA**

  Tests the infrared communications port. If no active infrared device is within range, the test result will be **Not Tested**.

- **Timebase**

  The Timebase test compares the Real Time clock to the System clock to check for discrepancies. It does not test the SpO_2 clock or the Biphasic clock.

- **DEFIB**

  The Defib test charges the defibrillator capacitor and then disarms it. It does not deliver the energy outside the unit. The pads cable and test load must be connected for the test to run; otherwise the test result will be **Not Tested.**

- **FE**

  The Front End (FE) test checks that the main processor is communicating with the Digital Signal Processor (DSP), and that the DSP is communicating with both ECG front ends (pads and leads). It does not test the quality of the ECG measurement.

- **SPO2** (if SpO_2 option installed)

  This tests that communication with the SpO_2 PCA is working. It does this by reading the software revision back from the PCA. It does not test the quality of the SpO_2 measurement.

- **Pacer** (if Pacing option installed)

  The Pacer test has the Pacer deliver current into the test box, and measures that the current delivered was what was expected. The pads cable and test load must be connected for the test to run; otherwise the test result will be **Not Tested.**

User Interface Tests

The User Interface Tests exercise the functions that interact with the user. Each of the User Interface tests assumes the unit and the simulator are still set up as they were at the end of the previous User Interface check.

If all results are as described, the unit passes that test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and the following specific tables:

- Table 3-11 "Operational Problems - Printer" on page 3-27.
- Table 3-12 "Operational Problems - Display" on page 3-28.
- Table 3-13 "Operational Problems - Audio Tones/Voice Prompts" on page 3-29.
- Table 3-14 "Operational Problems - Controls" on page 3-30.

To test the Controls:

1. **Access the Diagnostic Test menu.**

   See "Diagnostic Mode" on page 2-11.

2. **Start the Controls Test.**

   Select **Controls Test** and press ENTER. The screen will display a map of the front panel keys and Energy Select switch.

3. **Test the softkeys.**

   Press each of the numbered softkeys in turn. See Figure 2-1 on page 2-11 for numbering of softkeys. Each softkey number on the display should be highlighted each time that key is pressed.

   Don't press Softkey #4 MAIN at this time. This will return you to the Main diagnostic mode menu.

4. **Test the ECG and Audio keys.**

   Test each of the **ECG Size** and **Volume** keys. See Figure 2-1 on page 2-11 for location of these keys. Each key should show a highlighted ⊞ ("plus") when the up arrow on the key is pressed, and show a highlighted ⊟ ("minus") when the down arrow is pressed.

5. **Test the printer keys.**

   Test each of the printer control keys (**Strip**, **Summary**, and **Mark**). Each corresponding label on the display should be highlighted each time that key is pressed.

6. **Test the Pacing keys.**

   Test each of the Pacing keys. The displayed labels for **Pacer**, **Start/Stop** and **Mode** should be highlighted each time that key is pressed. The displayed labels for **Rate** and **Output** should show a highlighted ⊞ ("plus") when the up arrow on the key is pressed, and show a highlighted ⊟ ("minus") when the down arrow is pressed.

7. **Test the Energy Select Switch**

   Test the Energy Select Switch by turning it to each of the energy levels, and verifying that the **Rotary Knob** display changes from **Manual On** to **2J**, **3J**, **5J**, etc. Also turn the unit off, and enter Diagnostic Mode by pressing softkeys 4 and 6 while turning the Energy Select Switch to **AED On**. Verify that the **Rotary Knob** display shows **AED On**.

8. **End the test.**

   Press Softkey #4 MAIN to return to the Main diagnostic mode menu.

To test the display:

1. **Run the Display Test.**

   Select **Display Test** and press ENTER .

   The display should turn completely light, then completely dark, then a light vertical bar should scroll across the screen from left to right.

2. **Test the LEDs.**

   The display will show a TEST LEDs softkey label. Press this softkey and verify that the indicators in the Main and Pacing keypads each light in turn. The **AC Power** and **Batt Charge** LEDs will ***not*** light as part of this test.

3. **End the test.**

   Press Softkey #4 MAIN to return to the Main diagnostic mode menu.

To test the audio output:

1. **Start the Audio Test.**

   Select **Audio Test** and press ENTER . The screen will display the **Audio Test** menu.

2. **Select and run the desired test.**

   a. Press the ▲ and ▼ softkeys to move up or down the list to select the desired test. Then press ENTER to begin that test.

   Check the **Shutdown Warning** and the **Voice Prompt**; the other responses are given for reference. The results should be as described below.

   Press CANCEL to end that test and return to the main audio test menu.

   - **Message Alert** - A repeating series of 3 short tones, followed by a pause.
   - **Heart Rate Alarm** - 1 sustained tone of moderately high pitch.
   - **Charge Done Tone** - 1 sustained tone of lower pitch than the Heart Rate Alarm.
   - **Auto Disarm Warning** - A repeating series of 1 short tone and a pause.
   - **Shutdown Warning** - A repeating series of tones of alternating high/low pitch.
   - **Voice Prompt** - Voice should be clear and understandable.

3. **End the test.**

   Press Softkey #4 MAIN to return to the Main diagnostic mode menu.

To test the printer:

1. **Start the Printer Test.**

   a. Select **Printer Test** and press ENTER .

2. **Check the print quality.**

   a. Verify that the test patterns on the strip are as indicated in Figure 2-4.

   b. Check for white lines (printhead elements stuck off) or black lines (printhead elements stuck on).

   c. Check area “A” for stray marks or lines.

   d. The area of Figure 2-4 labeled “C” contains printouts of all characters and symbols. Verify that they are readable.

3. **Stop the printout.**

   Press CANCEL to end the test and return to the main Diagnostic Test menu.

4. **Verify the print speed.**

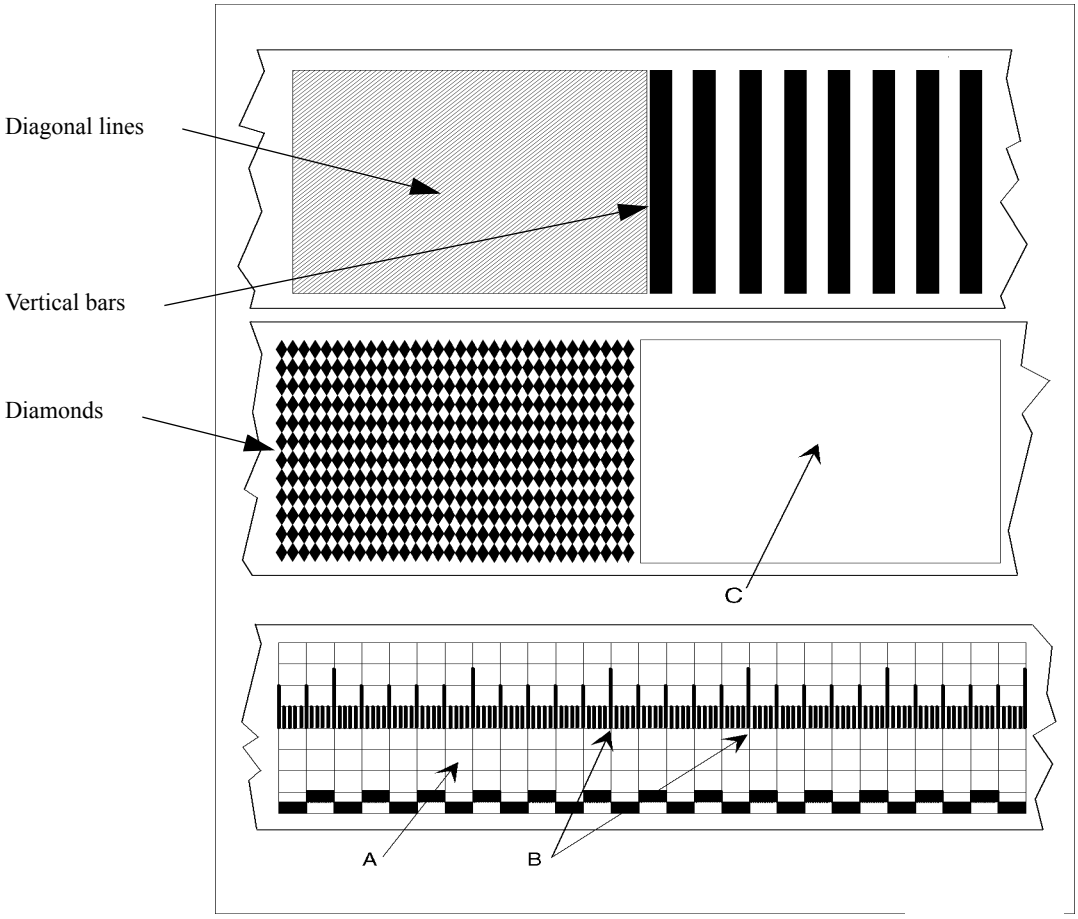
   Measure between the long tick marks (B in Figure 2-4) to verify paper speed. Distance should be 25mm ± 5% (±1.25 mm).

5. **Check the printer status detection.**

   a. Open the printer door and press the **Strip** key. The unit should sound a series of 3 tones indicating a printer problem.

   b. Take out the paper, close the door, and press the **Strip** key. The unit should sound a series of 3 tones indicating a printer problem.

Figure 2-4 Printer Test Output



ECG Tests

These instructions describe how to test the ECG functions.

Each of the ECG tests assumes the unit and the simulator are still set up as they were at the end of the previous ECG test.

If all results are as described, the unit passes that portion of the test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-7 "Operational Problems - ECG Monitoring (Pads, Paddles or Leads)" on page 3-20.

1. **Start the test.**

   a. Access the Diagnostic Test menu as described in "Diagnostic Mode" on page 2-11.

   b. Select **ECG Test** and press ENTER.

   c. The display should look similar to Figure 2-5:

Figure 2-5 ECG Test Display

MAIN	▼	▲	ENTER

ECG TEST

Selected Lead:	**Lead II**	
AC Line Filter:	**60 Hz**	**On**
Leads FE Status:	**Good**	
Pads FE Status:	**Good**	
DSP Status:	**Good**	
DC Offset:	**xxxx**	
Peak to Peak:		
Diagnostic:	**1050**	
Monitor:	**1090**	
PCI:	**51**	**Off**

2. **Check the settings.**

   a. **AC Line Filter**

   The AC Line Filter should be set to the correct frequency for your area.

   If the setting is incorrect, access the Configuration Mode and correct it. See "Configuration Mode" on page 2-10.

b. **Selected Lead**

This setting does not matter at this point. It will be changed later.

3. **Change the settings as needed.**

a. To temporarily change the settings of **Selected lead** or **AC Line filter**, press the ▲ and ▼ softkeys to highlight the parameter, then press (and release) ENTER to select it.

NOTE

The available choices for Selected Lead will depend on whether the unit is configured for 3-lead or 5-lead ECG monitoring.

b. After a few seconds the highlighted selection will begin to blink, and the ▲ and ▼ softkeys will allow you change the selection to another of the values available. When the value you want is displayed, press ENTER to set that value.

NOTE

These changes are only temporary, and will not override the configuration set in Configuration Mode.

4. **Check the ECG Status messages.**

The 3 status messages (**Lead FE, Pad FE, DSP**) should all be **GOOD**.

- The **Leads FE** test checks that communication is working between the Leads Front End (FE) and the Digital Signal Processor (DSP).
- The **Pads FE** test checks that communication is working between the Pads FE and the DSP.
- The **DSP** test checks that communication is working between the DSP and the rest of the monitor.

5. **DC Offset.**

This test is for manufacturing use only and should be ignored.

6. Test the ECG amplifier.

These tests measure both the gain and the noise of the two ECG amplifiers (Leads and Pads). Both use the **Peak to Peak** reading.

NOTE

The **Peak to Peak** reading measures the peak to peak amplitude of the signal appearing on the selected ECG input. If the simulator's calibrated output is 1.0 mV, then the **Peak to Peak** reading should be 1000 uV ± 10% (±100 uV) for both **Monitor** and **Diagnostic**. If the simulator output is calibrated to some other value, the displayed value should be (1000 x simulator output) ±10%. For example, if the output is 1.5 mV, the display should indicate 1500 uV ± 150 uV.

a. Perform the amplifier gain test:

1. Connect the ECG simulator to the pads cable. Set the simulator output for sine wave, 2 Hz or 10 Hz, 1 mV peak-to-peak. If the simulator in use does not have this capability, use an ECG waveform output whose peak-to-peak amplitude is accurately known.

NOTE

The menu for **Selected Lead** displays **Paddles** as a selection but not **Pads**. This is normal behavior in Diagnostic Mode. Use the **Paddles** menu selection for both pads and paddles.

2. Following the instructions under Step 3 on page 2-33 for changing settings, set **Selected lead** to **Paddles**. Only the **Monitor** frequency response will display a value; the **Diagnostic Peak-to Peak** value will be replaced by dashes (----).

3. Wait for the displayed value under **Monitor** to stabilize.

4. If the simulator output 1.0 mV peak-to-peak, the displayed value should be 1000 uV ±10% (±100 uV). (See the Note under step 6 "Test the ECG amplifier." on page 2-34.)

5. Connect the ECG simulator to the ECG leads cable (either 3-lead or 5-lead).

6. Following the instructions under Step 3 on page 2-33 for changing settings, set **Selected lead** to **Lead II**.

7. Wait for the displayed value under **Diagnostic** to stabilize.

8. If the simulator output is 1.0 me peak-to-peak, the displayed value should be 1000 uV ±10% (±100 uV). (See the Note under step 6 "Test the ECG amplifier." on page 2-34.)

b. Perform the amplifier noise test:

1. Turn the simulator off. Leave it connected to the ECG cable, and leave **Selected lead** set to **Lead II**.
2. Wait for the displayed value under **Diagnostic** to stabilize.
3. The displayed value should be 0 ± 30 uV.

NOTE

If the unit exhibits more than 30 uV of noise, try repositioning the cable or unit to minimize external interference. Also try various combinations of having the ECG simulator turned on or off, and (if applicable) whether the simulator is plugged into the AC mains. Refer to Chapter 7 for more information about reducing electromagnetic interference.

4. Following the instructions under Step 3 on page 2-33 for changing settings, set **Selected lead** to **Paddles**.
5. Connect the simulator to the pads cable.
6. Wait for the displayed value under **Monitor** to stabilize.
7. The displayed value should be 0 ± 30 uV.

7. **Test the PCI function.**

This test checks the PCI (Paddle Contact Indicator) function. The PCI measurement is used to detect Pads Off and Paddles Off, and to illuminate the Paddle Contact Indicator LEDs on PCI-equipped paddle sets. It is an approximate measurement only - the impedance value used to adjust the defibrillation waveform is a separate measurement, made during delivery of the shock. See "Theory of Operation" beginning on page 6-1 for more details.

a. Connect a set of external paddles to the M4735A. Make sure the metal surfaces of the paddles are clean and dry. Also make sure the slide-on adult paddle adapters are making good contact to the pediatric paddle surface.

b. If the PCI setting is **On**, turn it **Off** now by pressing the Volume Up and Down arrow keys simultaneously. (See Figure 2-1 on page 2-11.)

c. Remove the paddles from their holders and hold them firmly together, face to face (metal-to-metal). Be sure the paddles are clean and are making good contact with one another.

d. Turn the PCI setting **On** by pressing the Volume Up and Down arrow keys simultaneously. (See Figure 2-1 on page 2-11.) The displayed PCI value should now read 0 ± 15 ohms.

e. Place the paddles back in their holders. Be sure the metal contact clip in the holder is clean and makes good contact with the face of the paddle.

f. The PCI measurement should now read 50 ohms ± 30 ohms. If the reading is off, try wiggling the paddles in their holders. If the reading changes substantially when you do this, the contacts need cleaning. See step (a) above.

g. Remove the paddles from the holders and hold them apart. The PCI measurement should read > 1250 ohms (full scale).

Pacing Test

These instructions describe how to test the pacing function. This test only needs to be run if the Pacing option is installed.

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN.

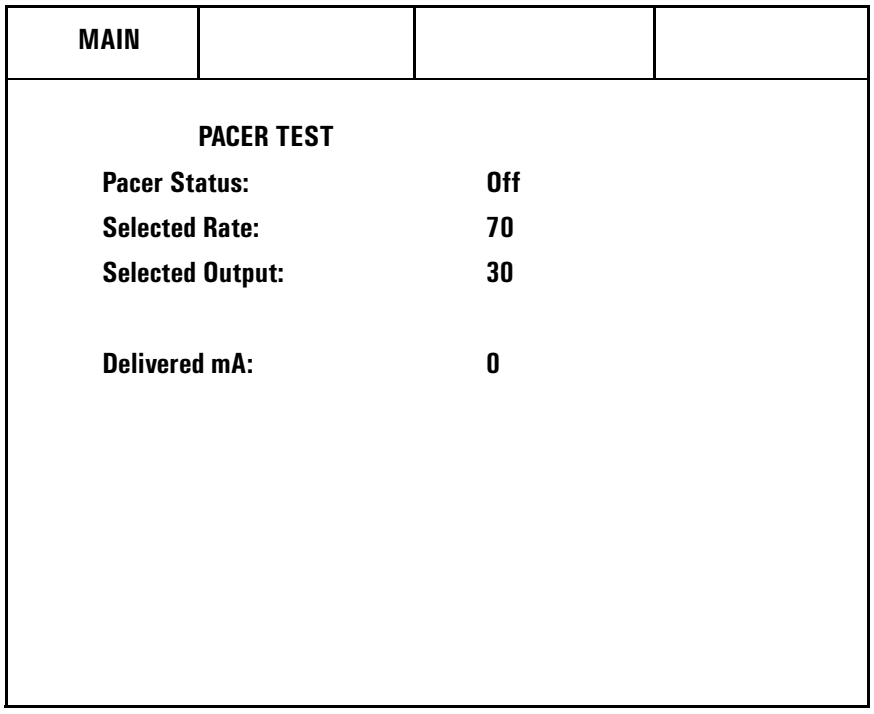
If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-10 "Operational Problems - Pacing" on page 3-26.

1. **Set up the test.**

   a. Disconnect the paddles and connect the pads cable. Connect the pads cable to the Pacer tester.

   b. From the Diagnostic Menu, select **Pacer Test** and press ENTER. The display should look similar to Figure 2-6.

Figure 2-6 Pacer Test Display



2. **Begin Pacing.**

   a. Press Pacer. The LED to the left of the button will illuminate. The screen display of **Pacer Status** will change to **Stopped.**

   b. Press Start Stop. **Pacer Status** will change to **Pacing**, and pacing will begin at the default settings of 70 beats per minute (bpm) and 30 mA.

3. **Check the default output.**

   a. The Pacer should be delivering a current of 30mA ±5mA.

   b. The display on the M4735A should read the delivered current as measured by the Pacer tester ±5 mA.

4. **Test the maximum output.**

   a. Using the 

button, increase the rate to 180 bpm.

   b. Using the 

button, increase the output to 200 mA.

   c. The Pacer should be delivering a current of 200mA ±20mA.

   d. The display on the M4735A should read the delivered current as measured by the Pacer tester ±20 mA.

5. **End the test.**

   Turn off Pacing by pressing the 

button.

Defibrillator Test (AC Power At 200 J)

These instructions describe how to test the defibrillation function when powered only by AC power (no battery installed).

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-9 "Operational Problems - Defibrillation and Synchronized Cardioversion" on page 3-24.

1. **Set up the test.**

   a. Turn defibrillator off and remove the battery. Connect the AC Power cord.

   b. Connect the defibrillator analyzer to the pads cable. Set the analyzer to measure delivered energy. If needed, reset the analyzer's display to read 0.

   c. Turn the defibrillator on. From the Diagnostic Menu, select the **Defib Meas Test** and press ENTER.

2. **Deliver a 200J shock.**

   a. Use the **Energy Select** control to select 200J.

   b. Press CHARGE to charge the defibrillator.

   c. Press SHOCK.

3. **Check the analyzer readings.**

   Read the delivered energy indicated by the defibrillator analyzer. It should be 200J ±15% (±30J).

4. **Check the values displayed by the M4735A.**

   The results displayed by the M4735A should be as follows:

Available Energy:	**Not recorded - failure if > 0.**
ms to Charge:	**≤15000**
Delivered Energy:	**Actual delivered energy ±7%**
Impedance:	**42 to 57 ohms**
Peak Current:	**Ignore. Derived from same measurements as delivered energy and impedance**
Defib Errors:	**Not recorded - failure if any reported.**
Shock Counter:	**Disregard.**

Defibrillator Test (Battery Power At 200 J)

These instructions describe how to test the defibrillation function when powered only by a fully charged battery, with no AC power connected.

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN. If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-9 "Operational Problems - Defibrillation and Synchronized Cardioversion" on page 3-24.

1. **Set up the test.**

   a. Turn the defibrillator off. Insert the battery and disconnect the AC Power cord.

   b. Connect the defibrillator analyzer to the pads cable. Set the analyzer to measure delivered energy. If needed, reset the analyzer's display to read 0.

   c. Turn the defibrillator on. From the Diagnostic Menu, select the **Defib Meas Test** and press ENTER.

2. **Deliver a 200J shock.**

   a. Use the **Energy Select** control to select 200J.

   b. Press CHARGE to charge the defibrillator.

   c. Press SHOCK.

3. **Check the analyzer readings.**

   Read the delivered energy indicated by the defibrillator analyzer. It should be 200J ±15% (±30J).

4. **Check the values displayed by the M4735A.**

   The results displayed by the M4735A should be as follows:

Available Energy:	**Not recorded - failure if > 0.**
ms to Charge:	**≤3000**
Delivered Energy:	**Actual delivered energy ±7%**
Impedance:	**42 to 57 ohms**
Peak Current:	**Ignore. Derived from same measurements as delivered energy and impedance**
Defib Errors:	**Not recorded - failure if any reported.**

NOTE

If the "**ms to Charge**" measurement is too high (unit takes too long to charge), verify that the battery is fully charged. If it is, the battery may simply be old. The 3000 ms specification is defined for a new, freshly charged M3516A battery. Replace the battery with one that is new and fully charged, and repeat the test.

Defibrillator Disarm Test

These instructions describe how to test the disarm function.

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN. If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1.

1. **Set up the test.**

   a. Turn the defibrillator off. Insert the battery and connect the AC Power cord.

   b. Connect the defibrillator analyzer to the pads cable. Set the analyzer to measure delivered energy. If needed, reset the analyzer's display to read 0.

   c. Turn the defibrillator on. From the Diagnostic Menu, select the **Defib Meas Test** and press ENTER.

2. **Charge and Disarm a 200J shock.**

   a. Use the **Energy Select** control to select 200J.

   b. Press CHARGE to charge the defibrillator.

   c. Press DISARM.

3. **Check the analyzer readings.**

   Read the delivered energy indicated by the defibrillator analyzer. It should be 0J or be blank.

4. **Check the values displayed by the M4735A.**

   The results displayed by the M4735A should be as follows:

Available Energy	**Not recorded - failure if > 0.**
Msec to charge	**Ignore - tested earlier**
Delivered energy	**Blank**
Impedance	**Blank**
Peak current	**Blank**
Defib errors	**Not recorded - failure if any reported.**

Safety Tests

This section covers tests of the M4735A's electrical safety. The Philips Safety Test designation for each test is provided for reference of Philips service personnel.

Test Notes

- Use the procedures called out by the manufacturer of the safety analyzer in use.
- Only test at the AC Mains (line) voltage used in the customer's facility - there is no need to test both 120 VAC and 240 VAC.
- Test both Normal and Reverse Polarity line connections for each test, and record the worst case value.
- If a ground reference point is needed for the testing, use the metal nut on the ECG Out (Sync) connector.

Earth Leakage

Leakage through earth (ground) wire of AC power cord.

1. Normal Condition (both AC line connections intact)

   Should be $\leq$ 300 uA (UL, 120 VAC).

   Should be $\leq$ 500 uA (IEC, 240 VAC)

   Record as "aaa".

2. Single Fault Condition (one AC line connection open)

   Should be $\leq$ 1000 uA.

   Record as "bbbb".

Patient Lead Leakage

Leakage out of (Source) or into (Sink) patient-connected inputs (Applied Parts).

1. ECG leads (IEC Type CF)
    1. Source
        a. Normal Condition (both AC line connections and earth ground intact)

        Should be ≤ 10 uA.

        Record as “cc”.

        b. Single Fault Condition (separately open neutral and open earth, each in turn)

        Should be ≤ 50 uA.

        Record as “dd”.
    2. Sink
        a. Single Fault Condition is with AC Mains voltage on Applied Parts

        (both AC line connections and earth ground intact)

        Should be ≤ 50 uA.

        Record as “ee”.

        b. Normal Condition (unit plugged into AC Mains and in Standby mode)

        Should be ≤ 10 uA

        (measured between all leads and earth)
    3. Auxiliary (each lead to every other lead) (record worst case value)
        a. Normal Condition (both AC line connections and earth ground intact)

        Should be ≤ 10 uA.

        Record as “ff”.

        b. Single Fault Condition (separately open neutral and open earth, each in turn)

        Should be ≤ 50 uA.

        Record as “gg”.

2. External Paddles/pads (IEC type BF)

    1. Source

        a. Normal Condition (both AC line connections and earth ground intact)

        Should be ≤ 100 uA.

        Record as “hhh”.

        b. Single Fault Condition (separately open neutral and open earth, each in turn)

        Should be ≤ 500 uA.

        Record as “iii”.

    2. Sink

        Single Fault Condition (with AC Mains voltage on Applied Parts)

        (both AC line connections and earth ground intact)

        Should be ≤ 5000 uA.

        Record as “jjjj”.

    3. Auxiliary (each lead to every other lead) (record worst case value)

        a. Normal Condition (both AC line connections and earth ground intact)

        Should be ≤ 100 uA.

        Record as “kkk”.

        b. Single Fault Condition (separately open neutral and open earth, each in turn)

        Should be ≤ 500 uA.

        Record as “lll”.

3. Internal Paddles (IEC type CF)

    1. Source

        a. Normal Condition (both AC line connections and earth ground intact)

        Should be ≤ 10 uA.

        Record as “mm”.

        b. Single Fault Condition (separately open neutral and open earth, each in turn)

        Should be ≤ 50 uA.

        Record as “nn”.

    2. Sink

        Single Fault Condition (with AC Mains voltage on Applied Parts)

        (both AC line connections and earth ground intact)

        Should be ≤ 100 uA.

        Record as “ooo”.

    3. Auxiliary (each lead to every other lead) (record worst case value)

        a. Normal Condition (both AC line connections and earth ground intact)

        Should be ≤ 10 uA.

        Record as “pp”.

        b. Single Fault Condition (separately open neutral and open earth, each in turn)

        Should be ≤ 50 uA.

        Record as “qq”.

Battery Capacity Test

The Battery Capacity Test is ***not*** part of the routine post-servicing Performance Verification. This test is part of the routine checks that the user performs. See the ***Instructions for Use*** (M4735-91900) for details on the frequency of the Battery Capacity test. It is included here for reference only.

To perform a Battery Capacity Test:

1. **Turn the M4735A off.**
2. **Label the unit.**

   Place a prominent label on the unit to indicate to others that the battery test is in progress and that the unit may not be used.
3. **Insert a charged battery.**

   If an AC power cord is connected, unplug it now.
4. **Run the test.**

   a. While pressing **Mark** , turn power on to start the test.

   b. Allow the test to proceed to completion. The test takes approximately three hours and is complete when test results print out and the device turns itself off.
5. **Check results.**

   Review the test results and take the appropriate action, as follows:

Table 2-3 Battery Capacity Test Results

If	Then
Elapsed Time ≥ 85 minutes and Low Battery Time ≥ 10 minutes	1. The battery passed the test. 2. Record “pass CT” and the date on the label on the bottom of the battery. 3. Recharge the battery before use.
Elapsed Time < 85 minutes or Low Battery Time < 10 minutes	1. The battery failed the test. 2. Record “fail CT” and the date on the label on the bottom of the battery. 3. Discard the battery appropriately.

NOTE

If the message "Unsupported Battery" appears, replace the battery with the M3516A battery. See Table 3-15 on page 3-31.

3 Troubleshooting

Overview

This chapter provides information about troubleshooting problems with the M4735A.

Chapter Contents

The major sections of this chapter are as follows:

Repair Philosophy

The repair philosophy of the M4735A is **subassembly replacement**. Examples of subassemblies are the printer, the Control PCA, and selected connectors and other items. Repairs that involve replacing individual components on a PCA are ***not*** supported.

CAUTION

Individual component replacement should ***not*** be attempted outside of a factory authorized repair facility. Component level repair is extremely difficult due to the extensive use of surface mount technology and the high parts-density on the circuit boards. Unauthorized component replacement can impair performance of the M4735A.

Equipment Required

Troubleshooting requires the same test equipment as does Performance Verification. See "Test Equipment" on page 2-9.

Troubleshooting and Repair Methodology

Following are the major topics covered:

Methodology Overview

We recommend using the methodology described below to isolate and repair problems with the M4735A. Each of these steps is explained in detail in the pages that follow.

Evaluate

This initial phase of the service call involves evaluating the operation of the M4735A and identifying problems. This is typically a broad search for information, with the goal being to find all useful “clues”, not to pinpoint a cause. At the end of this phase the problem(s) have been identified.

Troubleshoot

This phase of the service call begins by identifying a wide range possible causes for the problems observed. The work then becomes more focused, performing additional tests as needed to eliminate or prove the possible causes. At the end of this phase the cause(s) of the problem(s) are known.

Repair

Having identified the causes, focus now shifts to repairing those causes by replacing subassemblies as needed. At the end of this phase the unit is reassembled and working, and ready to be tested.

Verify

This final phase of the service call involves performing the appropriate level of Performance Verification testing, and documenting the results. At the end of this phase the unit is verified to be working correctly and can be returned to service.

Evaluate

Evaluating the situation is key to understanding what needs repair. Steps in the Evaluation should include those described below.

Interview the User

If possible, talk directly with the user who reported the problem. What were they were doing when the problem occurred? Exactly what happened with the unit? What was on the display? What tones or voice prompts were heard? Were there operational problems such as a noisy ECG trace?

Gather the External Components

The problems observed may turn out to be in the cables and accessories, not in the M4735A. If at all possible, obtain the cables, paddles, battery, etc. that were in use when the problem occurred, and use them in your evaluation. Also ask if any traces are available - often the printout yields valuable clues as to what exactly happened and when.

Perform a Visual Inspection

Thoroughly examine the unit and its cables and accessories. Refer to "Visual Inspection" on page 2-15.

Check the Unit

Identify problems with the unit by using the information gathered above, and following the steps below. If no trouble is found, proceed to the "Performance Verification and Safety Tests" chapter for instructions on what tests to run.

1. **Attempt to power up the M4735A.**

   a. Disconnect the AC Power cord (if connected).

   b. Insert a fully-charged M3516A battery into the unit.

   c. If the unit is used with a Data Card, insert a new, empty HeartStart XL-compatible Data Card (see Chapter 5 for listing) into the unit.

   d. Attempt to power up the unit by turning the Energy Select Switch to either **Manual On** or **AED On**.

2. **Evaluate the Response.**

   The unit will respond in one of the following 4 ways:

   a. **No response**

      IF The unit emits no sound, and no changes are visible on the display.

      THEN Troubleshoot further using Table 3-1 on page 3-9 ("Unit Unresponsive").

b. Minimal response

IF Unit provides only a slight response, such as a click or chirp from the speaker, or a change in the brightness or the borders of the display.

THEN Replace the Control PCA (see "Removal and Replacement" on page 4-1). Then return to this section and begin again with "Check the Unit".

c. Error message

IF The screen is blank except for an error message such as **System Failure - Cycle Power**.

THEN Turn power off then on. If the error does not repeat, proceed to "Troubleshoot" on page 3-5, particularly the section "System Errors". If the error repeats, replace the Control PCA (see "Removal and Replacement" on page 4-1). Then return to this section and begin again with "Check the Unit".

d. Powers up

IF The unit can
- generate tones or voice prompts, OR
- display text or graphics, OR
- respond to keypresses.

THEN Proceed to "Capture the Configuration Data" below.

Capture the Configuration Data

If possible, store the unit's configuration data on a Data Card or print out the current configuration. See "Configuration Mode" on page 2-10.

Print the System Log

Print out the System Log if possible, and use any error codes to help highlight problems. See "System Log" on page 2-22.

NOTE

The M4735A log of error codes only reports the last 10 errors. If new errors are created at this stage, they may overwrite the existing codes and valuable clues to the reported problem may be lost. Therefore, always attempt to print the System Log before proceeding.

Run the Extended Self Test

Perform the Extended Self Test to catch the errors it reports. See "Extended Self Test" on page 2-24.

Proceed to "Troubleshoot"

Now continue with "Troubleshoot" on page 3-5.

Troubleshoot

Once the problems are identified, follow the steps below to discover the causes of those problems. If no causes can be found, proceed to the "Performance Verification and Safety Tests" chapter for instructions on what tests to run.

Perform Functional Checks

As you develop your list of possible causes, perform Functional Checks as needed to confirm or disprove individual causes. See "Functional Checks" starting on page 2-17.

Run Diagnostic Tests

Use tests available in Diagnostic Mode to focus in on possible causes. See "Diagnostic Mode" on page 2-11, and start with "User Interface Tests" on page 2-27

Use the Troubleshooting Tables

Use the Tables provided starting on page 3-8 to identify the causes based on factors such as error codes and Extended Self Test failures

System Errors

If the unit displayed a System Message such as **System Failure - Cycle Power**, and the error did not repeat when powered up again, then check the error codes shown in the System Log.

- If the only error is # 10004, and the unit seems to be operating normally, then run ALL the Performance Verification Tests.
  - If the unit passes all tests, it can be returned to service. Be sure to document this event as you would any other problem.
  - If the unit fails any tests, troubleshoot and repair the unit as needed.
- If there are any errors other than #10004, troubleshoot and repair the unit as needed.

If the System Message repeats when powered up, troubleshoot and repair the unit as needed.

Repair

Once the causes are known, follow the steps below to perform the repair.

Check internal connections

It is always good practice to check the unit's internal connections before replacing any subassemblies. See "Removal, Handling, and Replacement" on page 4-2 for details.

Replace Defective Subassemblies

If the problems were not resolved by verifying internal connections, follow the procedures in the "Removal and Replacement" chapter to replace any defective subassemblies.

WARNING

Dangerous voltages may be present on components and connections exposed during unit disassembly. Use extreme caution while the unit cover is removed. Follow the instructions in "Discharge the Defibrillator Capacitor" on page 4-32.

CAUTION

Always discharge the power supply capacitors before servicing the M4735A. Follow the instructions given in "Discharge the Power Supply Capacitors" on page 4-26.

CAUTION

Be sure to work in a static free environment. Use an electrostatic wrist band. The work surface and area surrounding it must be static free. Use an antistatic pad which is grounded per the manufacturer's instructions.

Check the repair

When the repair is complete, it is good practice to check the repair by attempting to reproduce the specific problem found. It is also advisable to print the System Log again to check that no errors have been logged after the repair.

Once you are satisfied the problems have been repaired, proceed to "Verify" on page 3-7.

Verify

Use the procedures found in the "Performance Verification and Safety Tests" chapter to verify that the unit is operating properly. Be sure the testing performed is appropriate for the level of repair. The requirements for testing are described in detail beginning with "External Repairs/No Trouble Found" on page 2-2.

NOTE

If software upgrades were done as part of the repair process, point the customer to the Philips Documents and Downloads web site (www.medical.philips.com/goto/productdocumentation) for the latest versions of the HeartStart XL *Instructions for Use* and other documentation.

Troubleshooting Tables

Tables are provided to cover the troubleshooting topics below.

Using the Tables

The tables provide both ***Possible Causes*** and ***Corrective Actions***. Use them as follows:

- The ***Possible Causes*** are arranged in order of the approximate probability of their occurrence. Investigate them in the order given.
- For each ***Possible Cause***, try the ***Corrective Actions*** listed. If the first ***Corrective Action*** does not fix the problem, try the others in the order listed.
- If none of the ***Corrective Actions*** fixes the problem, then try the next ***Possible Cause*** listed.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

General Problems

The following tables describe general or system-level problems. For problems pertaining to a particular operation or function, see "Operational Problems" on page 3-20.

Unit Unresponsive

Isolate the fault by following the steps in Table 3-1, in the order listed.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-1 Unit Unresponsive

Do the steps below in numerical order.

Situation	Result	Possible Causes	Corrective Actions
1. Connect AC Power ONLY to unit.	“AC Power" indicator turns GREEN.	Normal response.	None. Proceed to step 2.
	"AC Power" indicator stays OFF.	No power in AC outlet. Power cord defective.	1. Restore power. 2. Replace power cord.
	"AC Power" indicator remains off after checking AC outlet and power cord connections.	One or more of the following may have failed: Power supply. Power PCA. Control PCA.	Isolate the fault by installing known good assemblies in the following order and replace as needed: 1. Power supply. 2. Power PCA. 3. Control PCA (leave replacement power PCA in unit).
2. Insert fully charged battery. Disconnect AC Power. Turn on power and observe unit’s response.	Unit powers up to some working state.	Normal response.	None. Proceed to step 3.
	Unit unresponsive.	Main Fuse open.	Replace Main Fuse.
		Open in battery wiring.	Check/replace Battery PCA and all of its connections.

Table 3-1 Unit Unresponsive *(Continued)*

Do the steps below in numerical order.

Situation	Result	Possible Causes	Corrective Actions
3. Connect AC Power to unit or fully insert a charged battery. Turn on power and observe unit's response.	Unit powers up to some working state.	Normal response.	None. Continue troubleshooting Operational Problems if necessary.
	Unit does not turn on or turns itself off.	Corrupt Data Card	1. Turn Energy Select knob to OFF position. 2. Replace Data Card with a new one, if available. 3. Turn on unit.
	Unit powers up with audio prompts/tone but no display.	Short or blown fuse in the display circuitry.	Isolate the fault by installing known good assemblies in the following order and replace as needed. 1. Display Assembly. 2. Control PCA and Display Assembly. 3. Keyscan PCA and new Control PCA.
	Unit still unresponsive.	Short or other failure somewhere in unit.	1. Replace Control PCA if not already replaced. 2. Replace Parameter PCA. 3. Replace Printer Assembly.
4. If all of the above are unsuccessful, return the unit for bench repair.			

Error Codes

The System Log provides error codes in 5 digit hexadecimal format, as shown below.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Confirm any errors by running the self-test again, making sure that no one touches the unit during the test.

Table 3-2 Error Codes

Error Code	Possible Causes	Corrective Actions
00000 - 00400	Defib failure - charging circuits.	1. Replace Power PCA. 2. Replace Control PCA.
01000	Defib failure - biphasic processor.	1. Replace Power PCA. 2. Replace Control PCA.
02000	Leads front end failure.	1. Replace Parameter PCA. 2. Replace Control PCA.
04000	Pacer failure.	Replace Power PCA.
08000	Processor error.	Replace Control PCA.
10000 - 1FFFF	System monitor failure.	1. Cycle power. 2. Replace Control PCA.
10001	Processor Synchronization Error	Cycle power. See"System Errors" on page 3-5.
10004	Synchronization Time Out	Cycle power. • If error does not repeat, run ALL Performance Verification Tests. If unit passes all tests, the unit can be returned to service. • If error repeats, replace Control PCA.
20000 - 2FFFF	Front end failure.	1. Replace Control PCA. 2. Replace Parameter PCA.
30000 - 3FFFF	Pacer failure.	1. Replace Power PCA. 2. Replace Control PCA.
40000 - 4FFFF	Monitor processor failure.	1. Replace Control PCA. 2. Replace Parameter PCA.
50000 - 5FFFF	SpO_2 problem.	1. Replace SpO_2 PCA. 2. Replace Parameter PCA. 3. Replace Control PCA.
60000 - 6FFFF	Advisory Failure.	Replace Control PCA.
80000 - 8FFFF	IRDA failure.	1. Replace Keyscan PCA. 2. Replace Control PCA.

Table 3-2 Error Codes *(Continued)*

Error Code	Possible Causes	Corrective Actions
90000 - 90002	Self Test failure - RAM/ROM or Gate Array.	1. Replace lithium battery. 2. Replace Control PCA.
90003	Self Test failure - Data Card circuits.	Replace Control PCA.
90004 and 90005	Self Test failure - Codec/time base.	1. Replace lithium battery. 2. Replace Control PCA.
90006	Self Test failure - SpO_2.	1. Replace SpO_2 PCA. 2. Replace Parameter PCA. 3. Replace Control PCA.
90007	Self Test failure - Pacer or Defib. This error can be caused by pressing the Pacer key during the self-test.	1. Run the self-test again, making sure not to touch the unit during the test. 2. Replace Power PCA. 3. Replace Control PCA.
90008	Self Test failure - Pacer or Defib.This error can be caused by paddles improperly seated in the pockets.	1. Make sure that the paddles are firmly seated in the pockets, and run the self-test again. 2. Check the circuit pathway from the paddles to the Power PCA. 3. Replace Power PCA. 4. Replace Control PCA.
90009	Self Test failure - Front End.	1. Replace Power PCA. 2. Replace Parameter PCA. 3. Replace Control PCA.
9000A	Lithium backup battery failure.	1. Replace lithium battery. 2. Replace Control PCA.
A0000-A7FFF	Data Card failure.	1. Replace Data Card. 2. Replace Control PCA.
A8000 - AFFFF	Data Archival error.	1. Replace Data Card. 2. Replace Control PCA.
B0000 - BFFFF	Audio failure.	Replace Control PCA.
F0000 - F0001	RAM/ROM failure.	Replace Control PCA.
F0002	Promo Mode failure.	Replace Control PCA.
F0003	Keyscanner failure.	1. Replace Keyscan PCA. 2. Replace Control PCA.
F0004	System Communication error.	Replace Control PCA.
F0007	System Communication error	Cycle power. See"System Errors" on page 3-5.

System Messages

System messages remain on the display until the specified action is taken or no longer relevant. They are intended for the end user and appear in the ***Instructions for Use***. System messages are duplicated here for the reference of the service person.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-3 System Messages

Message	Description	Corrective Action
Attach Pads Cable	The pads cable is not properly attached to the device.	Check the cable connection.
Configuration Lost	The configuration is reset to the default settings.	1. Reconfigure the M4735A. 2. If problem reoccurs, service the unit. See "Troubleshooting" on page 3-1. Look for problems with the Control PCA or the Lithium Backup Battery.
Data Card Disabled	The PC card is not in use because it is full, incompatible, absent, removed during the incident, or inserted after the M4735A was turned on.	If possible, turn the M4735A off for more than 2 minutes, then insert a new, empty, HeartStart XL-compatible Data Card (see Chapter 5 for listing) and turn the device on. You can also enter configuration mode and turn the device off, then on again.
ECG Fault	The ECG data acquisition system failed and data is unavailable from the 3- or 5-lead monitoring electrodes or from the pads/paddles.	Service the unit. See "Troubleshooting" on page 3-1.
Low Battery	The battery has sufficient capacity remaining to provide only about ten minutes of monitoring time and five shocks before the M4735A shuts off.	• Replace the battery with a fully charged M3516A battery. • Plug in AC power.
Leads Off	• The monitoring electrodes are not applied or are not making proper contact with the patient. • The monitoring cable is not connected. • The ECG cable is not connected. • The internal cable from the ECG connector to the Parameter PCA is disconnected • Failure on the Parameter PCA.	• Check that the monitoring electrodes are properly applied. • Check that the monitoring cable is properly connected. • Check that the ECG cable is properly connected. • Check the internal cable. • Replace the Parameter PCA.

Table 3-3 System Messages *(Continued)*

Message	Description	Corrective Action
No Paddles Connected	• The paddles are not properly connected to the device. • Failure on Control PCA. Failure on Power PCA.	• Check that the external paddles are connected. • Replace both Control PCA and Power PCA.
Pads Cable Off	The pads cable is not connected to the defibrillator. Failure on Power PCA.	Check that the pads cable connector is locked in place. Replace Power PCA.
Pads Off	The pads are not making proper contact with the patient. Failure on Power PCA.	Make sure the pads are properly applied to the patient. Replace Power PCA.
Defib Failure - Cycle Power	An error has occurred in the defibrillator subsystem.	See "System Errors" on page 3-5.
50J Maximum	When using internal paddles, the maximum energy delivered is limited to 50J.	Select a lower energy.
Pacer Failure	The pacing system is not functioning.	Service the unit. See "Troubleshooting" on page 3-1.
Pacer Output Low	The pacer is delivering less current to the patient than specified in the output current setting.	Check the pads are applied properly (patient impedance is high).
SpO2 Cable Off	The SpO_2 cable is not connected to the device.	Attach the SpO_2 cable to the M4735A.
SpO2 Light Interf	The level of ambient light is so high that the sensor cannot obtain an SpO_2 reading, or the sensor or cable is damaged.	1. Cover the sensor with an opaque material. 2. Check the sensor and cable for damage; try another sensor and cable.
Non Pulsatile	The patient's pulse is absent or too weak to be detected.	1. Check that the sensor is applied properly. 2. Make sure the sensor site has a pulse. 3. Relocate the sensor to a site with improved circulation. 4. Try another sensor.

Table 3-3 System Messages *(Continued)*

Message	Description	Corrective Action
SpO2 Low Signal	SpO_2 signal is too low to give an accurate reading.	1. Check the sensor is applied properly. 2. Try another sensor type.
SpO2 Noisy Signal	Excessive patient movement, electrical interference, or optical interference is present.	1. Minimize patient movement or apply the sensor to a site with less movement. 2. Secure the sensor cable loosely to the patient. 3. Reduce sources of electrical or optical interference.
SpO2 Sensor Fail	The SpO_2 cable is not connected to the device; or the cable or sensor are broken.	1. Attach the cable to the M4735A. 2. Replace cable and/or sensor.
SpO2 Failure	A failure has occurred in the SpO_2 circuitry.	1. Replace the SpO2 PCA. 2. Ensure that the flex circuit from the Spo2 PCA to the Parameter PCA is connected. 3. Replace the SpO2 connector.
System Failure - Cycle Power	A serious error has occurred.	See "System Errors" on page 3-5.
Service Unit	Appears during the Shift/System Check	1. Replace Data Card. 2. Replace lithium battery. 3. Replace Control PCA.

Momentary Messages

Momentary messages are temporary and only appear on the display for a few seconds. They are intended for the end user and appear in the ***Instructions for Use***. Momentary messages are duplicated here for the reference of the service person.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-4 Momentary Messages

Message	Possible Cause	Corrective Action
Attach Cable	The patient cable is not properly attached to the device.	Check the cable connections.
Attach Leads	The user attempted to begin pacing in Demand Mode without ECG leads attached to the patient.	Attach leads to patient.
Select Leads	With paddles connected and selected as the ECG input, the user attempted to activate Synchronized Cardioversion. With no leads connected, the user connected paddles and selected them as the ECG input, then connected the leads.	Use leads for ECG. Use leads for ECG.
Attach Pads	The multifunction defib electrode pads are not making proper contact with the patient.	1. Check the pads are applied to the patient, as directed on the package. 2. Replace pads if the prompt continues.
Attach Paddles	The user attempted to charge the defib in Manual Mode with no paddles connected.	Connect paddles.
Defib Disarmed	The defib is disarmed and no energy is available, due to one of the following: • The pads connection is compromised. • The mode is changed from Manual to AED while the defibrillator is charged. • **SHOCK** is not pressed within 30 seconds of the defibrillator being charged. • **DISARM** is pressed.	 • Check the pads are applied to the patient properly. • If a shock is indicated, deliver the shock before changing modes. • To deliver a shock, press **SHOCK** within 30 seconds of the defibrillator being charged. • None.
No Shock Delivered	Patient impedance is too high or too low.	1. Make sure pads are applied properly. 2. Replace the pads. 3. Replace the pads cable.
Check Printer	Printer paper is absent or jammed; the printer door is not closed properly.	1. Reload printer paper. 2. Make sure the door is closed properly.

Table 3-4 Momentary Messages *(Continued)*

Message	Possible Cause	Corrective Action
Data Card Full	No data is being recorded on the Data Card, due to one of the following: • The incident is more than 2 hours in duration, causing the Data Card to fill. • An empty Data Card was not inserted for the incident; the Data Card filled sooner than expected.	• None. A new Data Card can not be inserted during an incident. • Use one empty Data Card per incident/ patient to decrease the chance of the card filling.
Data Card Interrupted	No data is being recorded on the Data Card, because the Data Card was removed during an incident.	• During incident, none. The Data Card cannot be reinserted during an incident. • After incident, remove card, turn power off, wait at least 2 minutes, insert card, turn power on.
Data Card Not In Service	No data is being recorded on the Data Card, because the Data Card was inserted while the M4735A was on.	None. A Data Card must be inserted prior to turning the M4735A on for the current patient. Data Card will not record data until the M4735A is turned off for at least 2 minutes.
Incompatible Data Card	No data is being recorded on the Data Card. The Data Card inserted is not compatible with the HeartStart XL.	Use only HeartStart XL-compatible Data Cards (see Chapter 5 for listing).
No Data Card Present	A Data Card is not in the M4735A.	Turn the M4735A off and insert a Data Card prior to the first event for the patient.
Key Inactive	The key pressed is currently inactive (i.e. Pacer is inactive in AED Mode).	Use the appropriate mode for the key.
Stop Pacer	Mode is pressed while pacing pulses are being delivered.	Stop pacing before changing the pacing mode.

Audio Tones

The M4735A emits tones to alert you to its status.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-5 Audio Tones

Tone	Meaning	Suggested Action
At power on, a low tone of approx. 1 second followed by a series of short, higher-pitched, tones.	Normal power on sequence.	None needed.
At power on, a continuous beep of about 7 seconds.	System failure - processors not communicating.	Turn power off, then on. If problem reoccurs, replace Control PCA.
At any time, a repeating tone that alternates between two frequencies.	The unit emits this tone beginning 1 minute before shutdown due to low battery charge.	1. Connect an AC Power Cord or replace the battery with one that is fully charged. 2. Replace the AC Power Cord. 3. Service the unit. See "Troubleshooting" on page 3-1.

Extended Self Test Failures

Should the unit report a **FAIL** in the Extended Self Test, resolve it using the solutions below.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-6 Extended Self Test Failures

Failure	Possible Cause	Suggested Solution
RAM **ROM** **System** **CODEC** **IRDA** **Timebase**	Failure on Control PCA.	Replace Control PCA.
System FAIL 10	Lithium backup battery failure.	Replace lithium battery.
Data Card	Data Card full, or incompatible, or defective. Failure on Control PCA.	Replace Data Card with a new, empty HeartStart XL-compatible Data Card (see Chapter 5 for listing). Replace Control PCA.
Pacer **Defib**	Failure on Power PCA. Failure on Control PCA.	Replace Power PCA. Replace Control PCA.
FE	Failure on Control PCA. Failure on Power PCA. Failure on Parameter PCA.	Replace Control PCA. Replace Power PCA. Replace Parameter PCA.
SpO2	Failure on SpO_2 PCA. Failure on Control PCA.	Replace SpO_2 PCA. Replace Control PCA.

Operational Problems

These tables describe problems that may arise with specific functions or operations while using the M4735A.

ECG Monitoring

The following table covers problems that might arise while monitoring ECG.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-7 Operational Problems - ECG Monitoring (Pads, Paddles or Leads)

Symptom	Possible Cause	Suggested Solution
Noisy trace - constant noise on the baseline.	Incorrect configuration - power line frequency (50 or 60 Hz) or Filter settings.	Check/change configuration as needed.
	Nearby source of constant interference.	Try moving cable/leads; try relocating the unit.
	Bad connection somewhere in signal path.	Pads: Check connection between pads and adapter cable, also connection to unit. Paddles: Check connection to unit. Leads: Check connections between leads and trunk cable, also connection to unit.
	Failure in connector.	Pads: Replace Patient Connector. Paddles: Replace Patient Connector. Leads: Replace ECG Connector.
	Failure in ECG front end.	Pads: Replace Power PCA. Leads: Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.

Table 3-7 Operational Problems - ECG Monitoring (Pads, Paddles or Leads) ***(Continued)***

Symptom	Possible Cause	Suggested Solution
Noisy trace - intermittent bursts of noise or random spikes.	Nearby source of time-varying interference, such as radio transmitter (paging, walkie-talkies) or X-Ray system.	Try moving cable/leads; try relocating the unit.
	Bad connection somewhere in signal path.	Pads: Check connection between pads and adapter cable, also connection to unit. Paddles: Check connection to unit. Leads: Check connections between leads and trunk cable, also connection to unit.
	Failure in connector.	Pads: Replace Patient Connector. Paddles: Replace Patient Connector. Leads: Replace ECG Connector.
	Failure in ECG front end.	Pads: Replace Power PCA. Leads: Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.
Noisy trace - low frequency, periodic.	More than one instrument connected to the patient and active.	Only have one active instrument on the patient at a time.
Flat line - no waveform, no **Leads Off** or **Pads Off** message.	Short in internal ECG wiring or front end.	Pads: 1. Replace Patient Connector. 2. Replace Power PCA. Leads: 1. Replace ECG connector. 2. Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.
Leads Off message even though ECG cable has been replaced and is properly connected to the simulator.	Open in internal Leads ECG wiring or front end, due to:	
	Cable from ECG Connector to Parameter PCA has bad connection.	Reconnect cable properly. See "Servicing Notes" on page 4-1.
	Defective ECG Connector or cable to Parameter PCA.	Replace ECG Connector.
	Defective Parameter PCA	Replace Parameter PCA.

Table 3-7 Operational Problems - ECG Monitoring (Pads, Paddles or Leads) *(Continued)*

Symptom	Possible Cause	Suggested Solution
Pads Off message even though pads cable has been replaced and is properly connected to the simulator.	Open in internal Pads ECG wiring or front end, due to:	
	Cable from Patient Connector to Power PCA has bad connection.	Reconnect cable properly. See "Servicing Notes" on page 4-1.
	Defective Patient Connector or internal cable to Power PCA.	Replace Patient Connector Assembly.
	Defective Power PCA.	Replace Power PCA.
Trace distorted.	Failure in ECG front end.	Pads: Replace Power PCA. Leads: Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.
One or more ECG controls don't respond (e.g., select lead or ECG size).	Failure in keypress detection/processing.	1. Replace Control PCA. 2. Replace Keyscan PCA.
	Failure in keys/connections.	Replace Top Case Assembly.
Poor leads ECG signal quality. (See also "Noisy trace - constant noise on the baseline." on page 3-20 and "Noisy trace - intermittent bursts of noise or random spikes." on page 3-21).	The monitoring electrodes are not making proper contact with the patient.	Check that the monitoring electrodes are properly applied. If necessary, prepare the patient's skin and apply new electrodes.
	The monitoring electrodes are outdated or dried-out.	Check the date code on the electrodes. Do not open the electrode package until immediately prior to use.
	Radio frequency interference (RFI) is causing artifact.	Relocate or turn off equipment that may be causing RFI.
Poor paddles/pads ECG signal quality. (See also "Noisy trace - constant noise on the baseline." on page 3-20 and "Noisy trace - intermittent bursts of noise or random spikes." on page 3-21).	The paddles or multifunction pads are not making proper contact with the patient.	Check that the paddles or pads are properly applied. If necessary, prepare the patient's skin and reapply (or apply new pads).
	The multifunction pads are outdated or dried-out.	Check the date code on the pads. Do not open the pads package until immediately prior to use.
	Radio frequency interference (RFI) is causing artifact.	Relocate or turn off equipment that may be causing RFI.

Table 3-7 Operational Problems - ECG Monitoring (Pads, Paddles or Leads) ***(Continued)***

Symptom	Possible Cause	Suggested Solution
QRS beeper inaudible or beeps do not occur with each QRS complex.	The QRS beeper is configured to **Off**.	Configure the QRS beeper to **On**.
	The volume is set too low.	Adjust the volume.
	The amplitude of the QRS complex is too small to detect.	Adjust the size of the ECG.
Fails ECG Test in Diagnostic Mode.	Failure in Pads ECG front end or signal processing.	1. Replace Patient Connector. 2. Replace Power PCA. 3. Replace Control PCA.
	Failure in Leads ECG front end or signal processing.	1. Replace ECG Connector. 2. Replace Parameter PCA. 3. Replace Control PCA.

SpO_2 Monitoring

The following table covers problems that may arise while monitoring SpO_2.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-8 Operational Problems - SpO_2 Monitoring

Symptom	Possible Causes	Suggested solution
No response - no value on screen, no pleth bar.	Bad internal connection.	Carefully reseat flex cables between SpO_2 connector and SpO_2 PCA, and between SpO_2 PCA and Parameter PCA. See "Servicing Notes" on page 4-1.
	SpO_2 PCA failure.	Replace SpO_2 PCA.
	Control PCA failure.	Replace Control PCA.
	Parameter PCA failure.	Replace Parameter PCA.
Reads obviously wrong value.	Same as above.	Same as above.
Noisy/intermittent signal.	Same as above.	Same as above.

Defibrillation and Cardioversion

The following table covers problems that might arise while defibrillating or delivering synchronized cardioversion.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion

Message or Symptom	Possible Causes	Suggested solution
Won't charge in Manual Mode using button on paddles.	1. Paddles failure. 2. Internal failure in unit: • Patient connector or internal wiring failure. • Power PCA failure. • Control PCA failure.	1. Confirm paddles problem by charging using **CHARGE** key. Replace paddles if needed. 2. Troubleshoot further by: • Trying AED Mode. • Using Diagnostic Mode to run Extended Self Test and Defib Meas Test.
Won't charge in Manual Mode using **CHARGE** key.	• Patient connector or internal wiring failure. • Power PCA failure. • Control PCA failure. • Keyscan PCA failure. • **CHARGE** key failure.	Troubleshoot further by: • Trying AED Mode. • Using Diagnostic Mode to run Extended Self Test, Defib Meas Test and Controls Test.
Won't charge in AED Mode.	• Patient connector or internal wiring failure. • Power PCA failure. • Control PCA failure.	Troubleshoot further by: • Trying Manual Mode. • Using Diagnostic Mode to run Extended Self Test and Defib Meas Test.
Won't discharge in Manual Mode using buttons on paddles.	1. Paddles failure 2. Internal failure in unit: • Patient connector or internal wiring failure. • Power PCA failure. • Control PCA failure.	1. Confirm paddles problem by discharging using **SHOCK** key. Replace paddles if needed. 2. Troubleshoot further by: • Trying AED Mode. • Using Diagnostic Mode to run Extended Self Test and Defib Meas Test.
Won't discharge in Manual Mode using **SHOCK** key.	• Patient connector or internal wiring failure. • Power PCA failure. • Control PCA failure. • Keyscan PCA failure. • **SHOCK** key failure	Troubleshoot further by: • Trying AED Mode. • Using Diagnostic Mode to run Extended Self Test, Defib Meas Test and Controls Test.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion *(Continued)*

Message or Symptom	Possible Causes	Suggested solution
Charges, but disarms when press **SHOCK** or paddles buttons.	Patient impedance sensed as too high or too low during energy delivery due to: • Pads/paddles losing contact with patient. • Pads/paddles failure. • Pads cable failure. Power PCA failure. Control PCA failure.	Replace paddles, or pads and pads cable. Replace Power PCA. Replace Control PCA.
Charges, but disarms spontaneously.	1. Unit sensed **Pads Off** or **Cable Off** due to: • Pads/paddles losing contact with patient. • Pads/paddles failure. • Pads cable failure. • Power PCA failure. • Control PCA failure. • Keyscan PCA failure. 2. **DISARM** key failure (intermittent).	1. Replace paddles, or pads and pads cable. 2. Diagnose further as follows: In Diagnostic Mode, run Controls Test and test **DISARM** key. • Key tests OK: Replace 1) Power PCA 2) Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.
Charges slowly - about 4-5 sec. instead of 2-3 sec.	Battery too old or not fully charged. Unit senses unsupported battery due to: • Unsupported battery in use. • Battery PCA failure. • Power PCA failure. • Control PCA failure.	Replace with new, fully charged battery. Also run Battery Capacity Test on suspect battery (see page 2-46). Use only supported battery (M3516A/ M5516A). Diagnose further as follows: In Diagnostic Mode, start Battery Capacity Test (see page 2-46). • "**Unsupported battery**" on display: Stop test. Replace 1) Battery PCA 2) Power PCA 3) Control PCA. • No message on display: Stop test. Replace 1) Power PCA 2) Control PCA.
Doesn't deliver correct energy into Defibrillator Analyzer or delivers no energy at all. (Should also get message - **No shock delivered** or **Defib failure**.)	Control PCA failure. Power PCA failure.	Replace Control PCA. Replace Power PCA.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion *(Continued)*

Message or Symptom	Possible Causes	Suggested solution
Doesn't measure its own delivered energy correctly.	Power PCA failure. Control PCA failure.	Replace Power PCA. Replace Control PCA.
Not synchronizing even though ECG waveform OK on display.	Control PCA failure.	Replace Control PCA.
Fails **Defib Meas** Test in Diagnostic Mode (other then symptoms above).	Power PCA failure. Control PCA failure.	Replace Power PCA. Replace Control PCA.

Pacing

The following table covers problems that may arise while performing external pacing.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-10 Operational Problems - Pacing

Message or Symptom	Possible Causes	Suggested solution
Doesn't deliver correct current into Pacer Tester or delivers no current at all.	Control PCA failure. Power PCA failure.	Replace Control PCA. Replace Power PCA.
Doesn't measure its own delivered current correctly.	Power PCA failure. Control PCA failure.	Replace Power PCA. Replace Control PCA.
Doesn't pace at correct rate.	Control PCA failure.	Replace Control PCA.
Pacer hardware not installed message even though Pacer is present.	Bad connections - Manual Keypad flex circuits to Keyscan PCA.	Reconnect flex circuits properly. See "Servicing Notes" on page 4-1.
Unit fails either the Shift System Check or Extended Self Test, or reports error code 90007.	Test sequence is interrupted.	Run the test again, making sure that no one touches the unit during the test.

Printer

The following table covers problems that may arise while printing.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Also check for damage to the printer ribbon cable where the ribbon is captured in the connectors on each end.

Table 3-11 Operational Problems - Printer

Symptom	Possible Causes	Suggested solution
Paper won't move.	Paper improperly loaded or jammed, or paper is wet. Printer failure.	Reload paper or clear jam. If paper is wet, replace with fresh dry roll. Replace printer.
Paper moves then stops.	Door improperly latched. Paper improperly loaded or jammed.	Check door latch. Reload paper or clear jam.
Paper moves but printing is faint or absent.	Door improperly latched. Dirty printhead. Printer failure. Control PCA failure.	Check door latch. Clean printhead. Replace printer. Replace Control PCA.
Paper moves but print quality poor or some dots missing.	Dirty printhead. Printer failure.	Clean printhead. See"Cleaning the Printer Printhead" on page 4-6. Replace printer.
Loud buzzing or grinding noise.	Door improperly latched.	Check door latch.
Waveforms or text distorted even though they look OK on display.	Printer failure. Control PCA failure.	Replace Printer. Replace Control PCA.
Black line running along paper.	Dots (printhead elements) stuck on due to: • Printer failure. • Control PCA failure.	 Replace Printer. Replace Control PCA.
White line running along paper.	Dirt on printhead. Dots (printhead elements) stuck off due to: • Printer failure. • Control PCA failure.	Clean printhead. See "Cleaning the Printer Printhead" on page 4-6. Replace Printer. Replace Control PCA.

Table 3-11 Operational Problems - Printer *(Continued)*

Symptom	Possible Causes	Suggested solution
Fails Printer Test in Diagnostic Mode (other then symptoms above).	Printer failure.	Replace Printer.
	Control PCA failure.	Replace Control PCA.

Display

The following table covers problems that may arise with the display.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-12 Operational Problems - Display

Symptom	Possible Causes	Suggested solution
No response - all light or all dark.	Display failure	Replace display.
	Control PCA failure.	Replace Control PCA.
	Keyscan PCA failure.	Replace Keyscan and Control PCA.
No response - display completely dark. No audio prompts and no LEDs lit.	Subassembly failure other than those noted above.	See Table 3.1 "Unit Unresponsive" for guidance.
Fails Display Test in Diagnostic Mode (display problem other then symptoms above).	Display failure.	Replace Display.
	Control PCA failure.	Replace Control PCA.
Fails Display Test in Diagnostic Mode (indicator LEDs).	Control PCA failure.	Replace Control PCA.
	Pacer Keypad or Main Keypad failure.	Replace Pacer Keypad or Bezel Assembly.

Audio

The following table covers problems that may arise with the audio tones or voice prompts.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-13 Operational Problems - Audio Tones/Voice Prompts

Symptom	Possible Causes	Suggested solution
No audio at all.	Speaker failure. Control PCA failure.	Replace Speaker Assembly. Replace Control PCA.
Audio is distorted.	Damage to speaker label. Speaker failure. Control PCA failure.	Replace speaker label. Replace Speaker Assembly. Replace Control PCA.
Buzzing noise when audio active.	Damage to speaker label. Debris between speaker and speaker label. Speaker hardware loose. Speaker failure. Control PCA failure.	Replace speaker label. Remove speaker label, clean out debris, install new speaker label. Tighten hardware as needed. Replace Speaker Assembly. Replace Control PCA.
Tones present but no voice prompt (in AED Mode).	Control PCA failure.	Replace Control PCA.
Voice prompt present but no tones.	Control PCA failure.	Replace Control PCA.

Controls

The following table covers problems that might arise with the controls.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-14 Operational Problems - Controls

Symptom	Possible Causes	Suggested solution
One of the keys doesn't respond correctly.	• Key failure. • Keyscan PCA failure. • Control PCA failure.	Diagnose as follows: In Diagnostic Mode, run Controls test and identify all unresponsive keys. • Some keys don't respond: Replace 1) Keyscan PCA 2) Control PCA 3) Bezel Assembly. • All keys don't respond: Replace 1) Keyscan PCA 2) Control PCA.
More than one of the keys, or all of the keys, don't respond correctly.	• Keyscan PCA failure. • Control PCA failure. • Keypanel failure.	
The Energy Select Switch doesn't respond correctly.	• Keyscan PCA failure. • Control PCA failure. • Switch failure.	Diagnose as follows: In Diagnostic Mode, run Controls test and test Switch. • Some switch selections don't respond: Replace 1) Switch 2) Control PCA 3) Keyscan PCA. • All switch selections don't respond: Replace 1) Keyscan PCA 2) Control PCA 3) Switch.

Battery and Charging Circuits

The following tables cover problems that may arise with the Battery or the unit's battery charging circuits.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-15 Operational Problems - Battery, Charging Circuits

Symptom	Possible Causes	Suggested solution
Low battery life (depletes quickly in use).	Very frequent use - not charging long enough between uses.	Charge fully between uses. Use spare batteries and adapters as needed to allow complete charging.
	Battery failure.	Run Battery Capacity Test (see "Battery Capacity Test" on page 2-46). If battery fails test, replace battery.
	Power Supply failure.	Replace Power Supply.
	Failure on Control PCA, Power PCA, or Battery PCA.	Replace 1) Control PCA 2) Power PCA 3) Battery PCA.
Fails Battery Capacity Test	Battery old, worn out, or failed.	Replace battery.
	Failure on Control PCA.	Replace Control PCA.
"Unsupported Battery" message appears on the screen	• Not an M3516A battery.	• Use an M3516A battery only.
	• Battery damage.	• Replace the battery.
	• Failure on battery PCA.	• Replace the Battery PCA.

Table 3-16 Power Indicator Matrix

INDICATORS		SYSTEM STATE			MEANING
AC POWER	BATT CHARGING	Connected to AC Mains?	Battery in Place?	Unit Power ON?	
G = GREEN OR = ORANGE/AMBER		Y = YES N = NO --- = don't care			
OFF	OFF	N	---	---	Normal
G	OFF	Y	N	---	Normal
G	OR	Y	Y	---	Battery is charging.
G	G	Y	Y	---	Battery at least 90% charged.

Data Card

The following table covers problems that may arise with the Data Card.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-17 Operational Problems - Data Card

Symptom	Possible Cause	Corrective Action
Data card is not recognized when plugged in.	Unit power is already on. Card is only recognized during power-up sequence.	Turn power off for 2 minutes, then on again.
	Card is full or not a supported type.	Use a new, empty HeartStart XL-compatible Data Card (see Chapter 5 for listing).
	Failure on Data Card.	Replace Data Card.
Data on the card corrupted.	The card was removed while the unit's power was on.	Only remove Data Card after power is turned off. Delete corrupted files using the Event Review Data Management System.
	Failure on Data Card.	Replace Data Card.
Fails Data Card Test in Diagnostic Mode	Card is full or not a supported type.	Use a new, empty HeartStart XL-compatible Data Card (see Chapter 5 for listing).
	Failure on Data Card.	Replace Data Card.
	Failure on Control PCA.	Replace Control PCA.

Calling for Service

For telephone assistance, call the Philips Response Center nearest to you, or visit our website at: www.medical.philips.com/cms and follow the link for service.

North America

Canada	800-323-2280
United States of America	800-722-9377

Latin America

Medical Response Center	954-835-2600

Europe

European International Sales	800-323-2280
Austria	01 25125 333
Belgium	02 778 3531
Finland	09 615 80 400
France	0803 35 34 33
Germany	01805 47 50 00
Italy	0800 825087
Netherlands	040 278 7630
Switzerland	0800 80 3000 (German) 0800 80 3001 (French)
United Kingdom	07002 43258472

Asia/Asia Pacific

Australia	1800 251 400
China (Beijing)	800 810 0038
Hong Kong **Macau**	852 2876 7578 0800 923
India **New Delhi** **Mumbai** **Calcutta** **Chennai** **Bangalore** **Hyderabad**	 011 6295 9734 022 5691 2463/2431 033 485 3718 044 823 2461 080 5091 911 040 5578 7974
Indonesia	021 794 7542
Japan	0120 381 557
Korea	080 372 7777 02 3445 9010
Malaysia	1800 886 188
New Zealand	0800 251 400
Philippines	02 845 7875
Singapore	1800 PHILIPS
Thailand	02 614 3569
Taiwan	0800 005 616

Equipment Information

Use the table below to summarize information you'll need when calling for service.

Model Number	Serial Number	Location (Dept.)

Biomedical Warranty or Support Contract Number

_____

4 Removal and Replacement

Overview

This chapter provides procedures for removing and replacing subassemblies of the M4735A. Most of the subassemblies described are available as replacement parts. However, some of those described are ***not*** available, and are included because they need to be removed to service other subassemblies. For a complete listing of which subassemblies are available as replacement parts, see "Replacement Parts" beginning on page 5-1.

Chapter Contents

The major sections of this chapter are as follows:

Servicing Notes

Following are some important points to keep in mind whenever servicing the M4735A.

Key Components

Replacement assemblies marked with an asterisk (*) in the Replacement Parts tables contain one or more Key Components. Key Components require detailed tracking, by recording the key component part number and either the key component's date code or its serial number. This data must be recorded for both the failed assembly and the replacement assembly.

Philips Technologies service personnel must record this information on the Customer Service Order (CSO).

The Key Components that are part of the replacement assemblies are listed in Table 5-18 on page 5-22.

Removal, Handling, and Replacement

The following sections give details of how to successfully work with the internal assemblies of the M4735A.

Flex Circuit Connections

In order for flex circuit connections to function properly, they must be disconnected and reconnected as follows:

- Always unlatch the PCA-mounted connector before removing the flex circuit, and hold the latch open while reinserting the flex circuit into the connector.
- When reconnecting, align the flex circuit carefully in its receptacle. Make sure it is both centered from side to side in the connector and oriented at 90 degrees to the connector.
- Be sure the flex circuit is fully seated in the connector and the connector is properly latched.

Flex Circuit Handling

The flex circuits are delicate and can be damaged by improper handling:

- Do not bend sharply.
- Do not scrape the contact surface against other parts.
- Handle the flex with bent tip needle nose pliers whose jaws are covered with a soft material (such as plastic tubing or tape).

Internal Connections

Whenever troubleshooting indicates a particular PCA may be at fault, it is always good practice to check all the connections to that PCA and retest before replacing the PCA.

Cable and Assembly Placement

How the wires and cables are routed and dressed inside the chassis plays an important role in two areas: in preventing long term wear problems, and in reducing electromagnetic and radio frequency interference emitted by the defibrillator.

- When you disassemble any part of the defibrillator, pay special attention to how cables and wires are routed.
- When you reassemble the defibrillator, be sure to route and dress all cables and wires as they were originally.
- Return all components to their original position within the case.

Instrument Reassembly

If you do not reassemble the instrument correctly, the instrument may no longer be properly sealed. This could result in water damage to the defibrillator. Be sure to maintain the water-resistant seal by:

- Replacing all gaskets in their proper locations.
- Correctly assembling all parts that mate with gaskets (making sure the gaskets are not wrinkled or pinched).
- Replacing all screws.
- Making sure that screws are not cross-threaded and that they are tightened firmly.

Tool Requirements

The following tools are needed to perform the procedures in this chapter.

- Torx T10 and T15 drivers (or Torx driver kit, part number 5181-1933). T15 driver shaft should be at least 2.25" long and less than 5/16” in diameter to reach down to recessed case screws.
- Slip-joint pliers or adjustable open-end wrench.
- Small, straight-bladed screwdriver.
- Straight-tip needle nose pliers or tweezers.
- Bent-tip needle nose pliers whose jaws are covered with a soft material (such as plastic tubing or tape).
- Fine-nose wire cutters.
- Utility knife.
- High voltage discharge tool for discharging the defibrillator capacitor (part number M2475-69572).
- Clip leads (at least 2, each approx. 10-18”).
- Language Support Tool (see Table 5-2 on page 5-6 for part numbers)

Disposal

Disposing of the M4735A

Prior to disposing of the M4735A, remove the battery. Then dispose of the device in accordance with local standards.

WARNING **Disposal of the device with the battery inserted presents a potential shock hazard.**

Disposing of the SLA Battery

The M3516A battery utilizes Sealed Lead Acid (SLA) technology. Dispose of the battery or recycle it according to local regulations for lead-containing products.

External Assemblies

This section describes how to remove and replace assemblies that are external to the case. These assemblies include:

CAUTION

Be sure to work in a static safe environment. The work surface and area surrounding it must be static free. Use a static control wrist band, in conjunction with an antistatic pad which is grounded per the manufacturer's instructions.

User Replaceable Parts and Accessories

The ***Instructions for Use*** gives detailed instructions on replacing the following:

- Patient cables & sensors
- Battery
- Printer paper

User Maintenance

The ***Instructions for Use*** gives detailed instructions on maintaining and cleaning the M4735A, including:

- Operational Checks
- Battery Maintenance
- Cleaning Instructions

For the convenience of the service person, instructions on cleaning the printer printhead are duplicated here. Instructions on running the Battery Capacity Test are duplicated on page 2-46.

Cleaning the Printer Printhead

If the traces or characters in the printout are faint or vary in density (darkness), clean the printhead to remove any buildup of paper residue.

1. **Open the printer and remove the paper**
   a. Slide the printer door to the right until the paper roller pops up.
   b. Pull up on the plastic tab to remove the roll of paper.
2. **Clean the printhead**

   Clean the printhead surface (above the brush) with a cotton swab dipped in isopropyl alcohol. Take care to not leave cotton fibers behind.
3. **Replace the paper.**
4. **Close the printer door.**

Printer Assembly

The following steps describe how to remove and replace the printer assembly.

Preparation

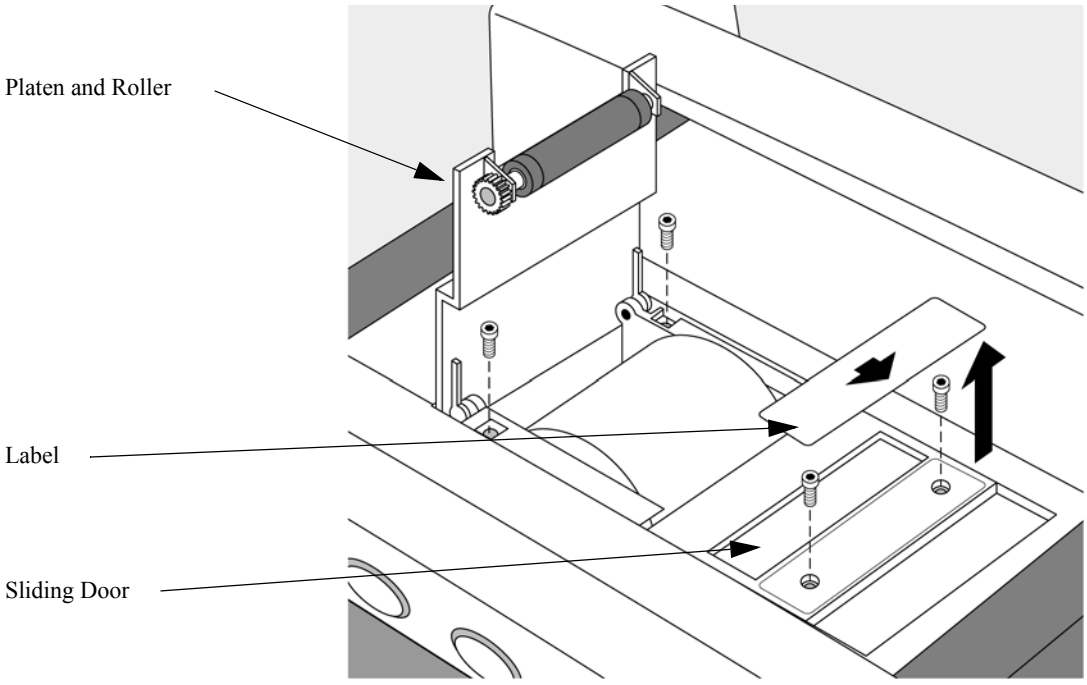
1. **Discharge the power supply capacitors.**
   a. Disconnect the AC power and remove the battery.
   b. Turn the Energy Select Switch to either **AED On** or **Manual On**.
   c. Wait at least **one full minute** before proceeding. This will allow enough time for the capacitors to discharge.
2. **Open the printer and remove the paper**
   a. Open the printer by moving the sliding door in the direction of the arrow and lifting up the platen and roller.
   b. Pull up on the plastic tab and lift the paper out of the printer.

Removal

1. **Loosen the 2 screws under the platen.**

   Loosen the (2) T10 screws now visible on the top and bottom edges of the printer assembly at the left end. See Figure 4-1 on page 4-8.
2. **Remove the label and loosen the other 2 screws.**
   a. Using a utility knife, pick up one corner of the label.
   b. Peel the label up by pulling slowly and evenly on the loosened corner.
   c. Loosen the (2) T10 screws under the label.

Figure 4-1 Removing the Printer Label and Screws



3. **Remove the printer assembly.**

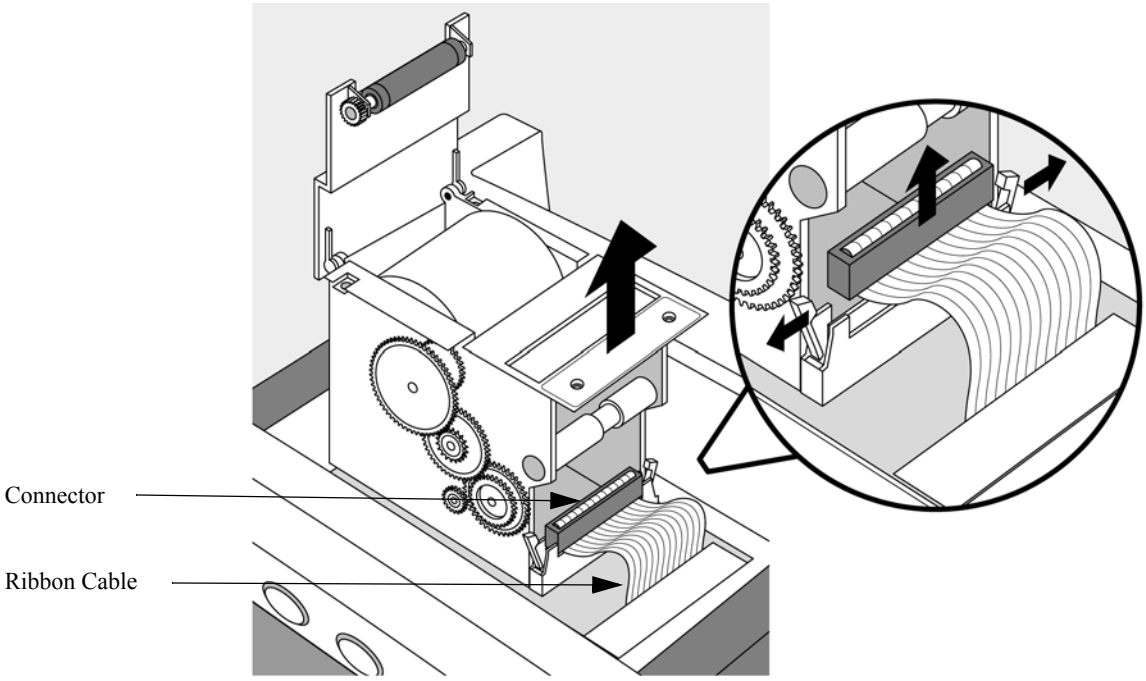
   Pull the printer straight up out of the printer bucket. See Figure 4-2 on page 4-9.

4. **Disconnect the ribbon cable.**

   Unlatch the connector latches and unplug the ribbon cable as shown in See Figure 4-2 on page 4-9.

   TIP: If you are installing a replacement printer, remove the 4 screws now. If you are moving the printer to a new Top Case Assembly, save work by leaving the screws in place.

Figure 4-2 Removing the Printer



Replacement

1. **Replace the 4 screws.**
   a. Open the paper door.
   b. Place the 4 screws in their holes in the printer. Use tweezers or fine nose pliers to replace the 2 screws under the sliding door.
2. **Reconnect the ribbon cable.**
   a. Align the ribbon connector and push it straight into the connector on the printer.
   b. Engage the 2 latches on the ends of the connector.
3. **Lower the printer straight down into the instrument.**
4. **Tighten all 4 screws.**
5. **Replace the label.**
   a. Remove any adhesive residue by rubbing the dry surface with your finger and “rolling up” the adhesive residue. Solvents are ineffective, as is scraping with a tool.
   b. Clean the surface with isopropyl alcohol. Allow it to dry.
   c. Peel the backing off the new label. Avoid touching the label adhesive.
   d. Align one edge of the label with the recess on the sliding door, then roll the label down into position.
   e. Press firmly all over the label, especially the edges, to ensure it adheres to the door.
6. Replace the paper and close the door.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Battery Cover

The instructions that follow describe how to remove and replace the battery cover.

Preparation

1. **Remove the battery.**
2. **Remove the paddles from their retainers and unplug them from the unit.**
3. **Turn the unit over.**

   Turn the unit upside down with the handle facing you. The battery cover is at left side of the bottom surface.

Removal

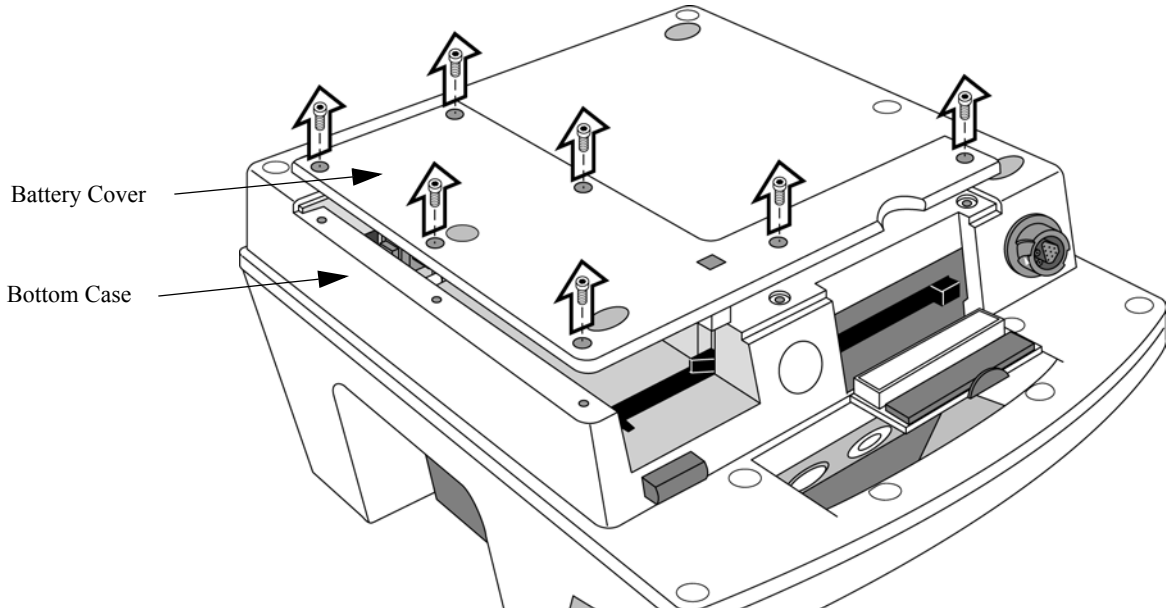
1. **Remove the battery cover.**

   Remove the 7 screws as shown in Figure 4-3.

   TIP: The screws are size-coded. Remove only the T10 screws.

2. **Lift the battery cover up.**

Figure 4-3 Removing the Battery Cover



Replacement

1. **Check the Battery PCA and the Battery Eject Spring.**

   a. Ensure the lower edge of the Battery PCA is seated in its slot in the case

b. Check that the Battery Eject Spring is all the way at the bottom of its slot.

c. Check the orientation of the Battery Eject Spring. Correct orientation is when the spring is angled slightly toward the Battery PCA, and ***not*** angled up out of the battery compartment. Adjust the angle of the spring as needed by turning it while keeping it in place in its slot.

2. **Insert a battery to compress the springs and position the PCA.**

   a. Slide a battery into the battery compartment. Be sure the battery stays flat and does not push up out of position.

   b. As the battery latches into place, it will push the Battery PCA into position and compress both the Battery Eject Spring and the Battery PCA Spring.

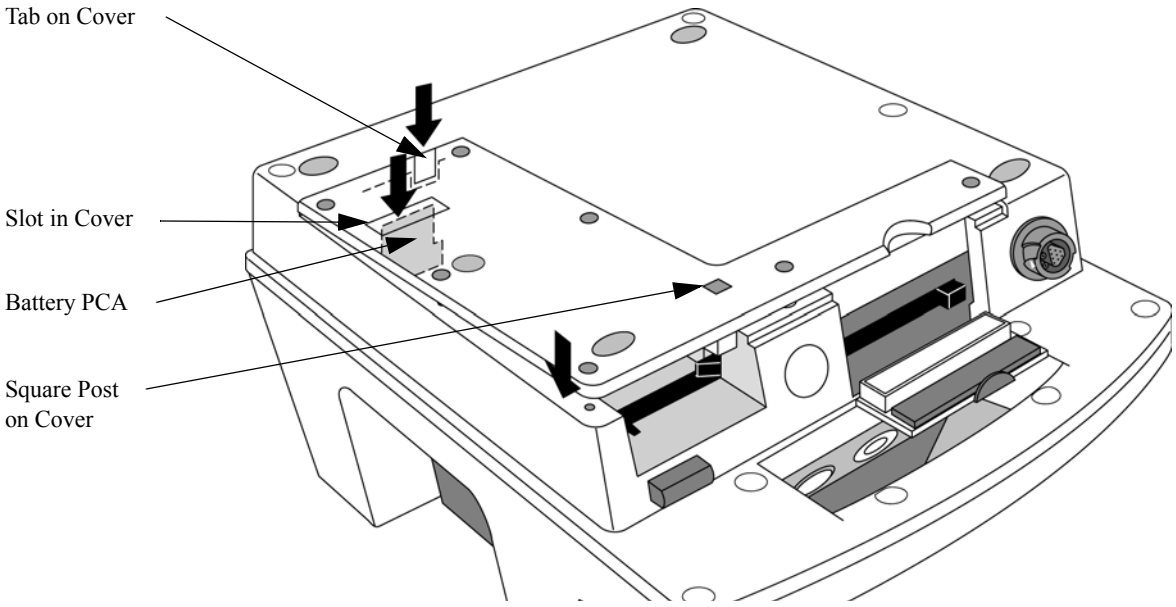
3. **Replace the Battery Cover.**

   a. While keeping the battery in place, replace the battery cover starting with the end by the battery PCA. See Figure 4-4.

   b. Insert the tab on the cover into the mating slot next to the battery spring. Then lower the cover into position, allowing the square post on the cover to mate with the recess in the case.

   c. Replace all 7 screws and tighten.

Figure 4-4 Installing the Battery Cover



After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Main Fuse

The main fuse is located on the Battery PCA, which is under the Battery Cover.

Removal

1. **Remove the Battery Cover**

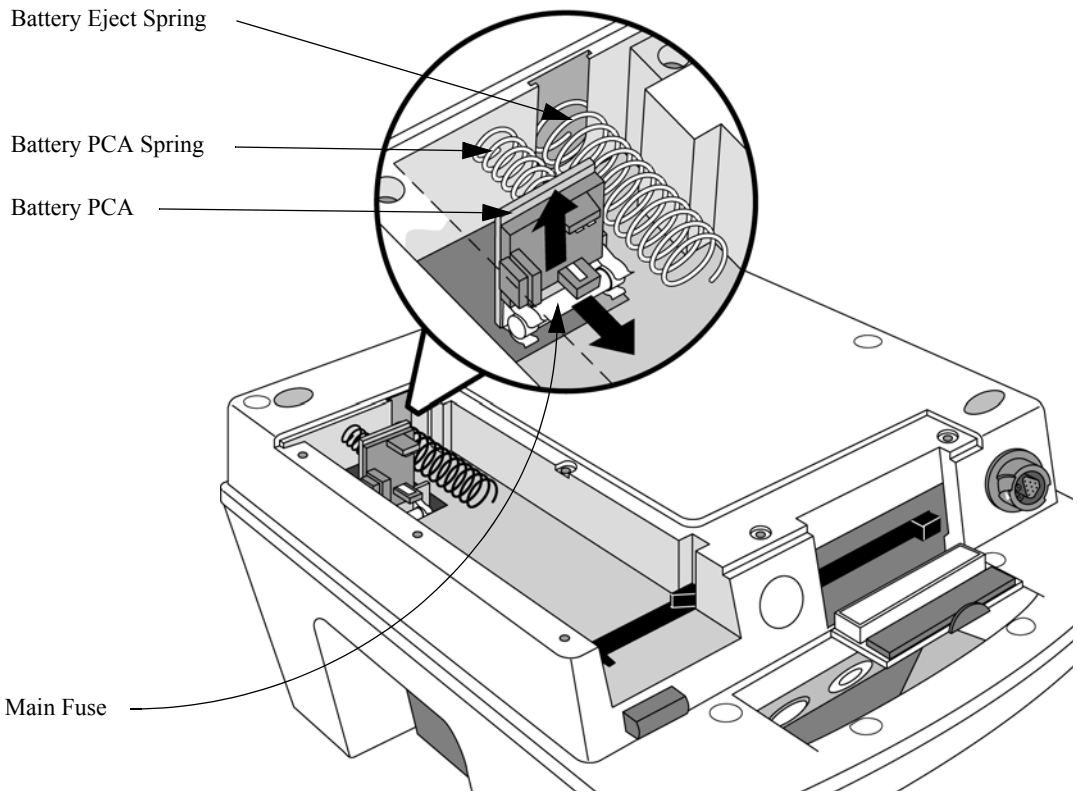
   See "Battery Cover" on page 4-11.

2. **Remove the fuse.**

   a. Pull out the Battery PCA far enough to access the fuse.

   b. Remove the fuse by pulling straight up from PCA as shown in See Figure 4-5 on page 4-13.

Figure 4-5 Removing the Main Fuse



Replacement

1. **Snap the new fuse into position on the PCA.**
2. **Restore the Battery PCA to its original position.**

   Push the Battery PCA back into the case, being sure the lower edge of the PCA engages the slot in the bottom case.
3. **Replace the battery cover.**

   See "Battery Cover" on page 4-11.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Battery Eject Assembly

The Battery Latch engages when the battery is fully inserted in the battery compartment, and it is released by pushing the Battery Eject Button.

Removal

1. **Remove the Battery Cover**

   See "Battery Cover" on page 4-11.

2. **Remove the Battery Eject Button.**

   a. Press the Battery Eject Button all the way in and hold it in.

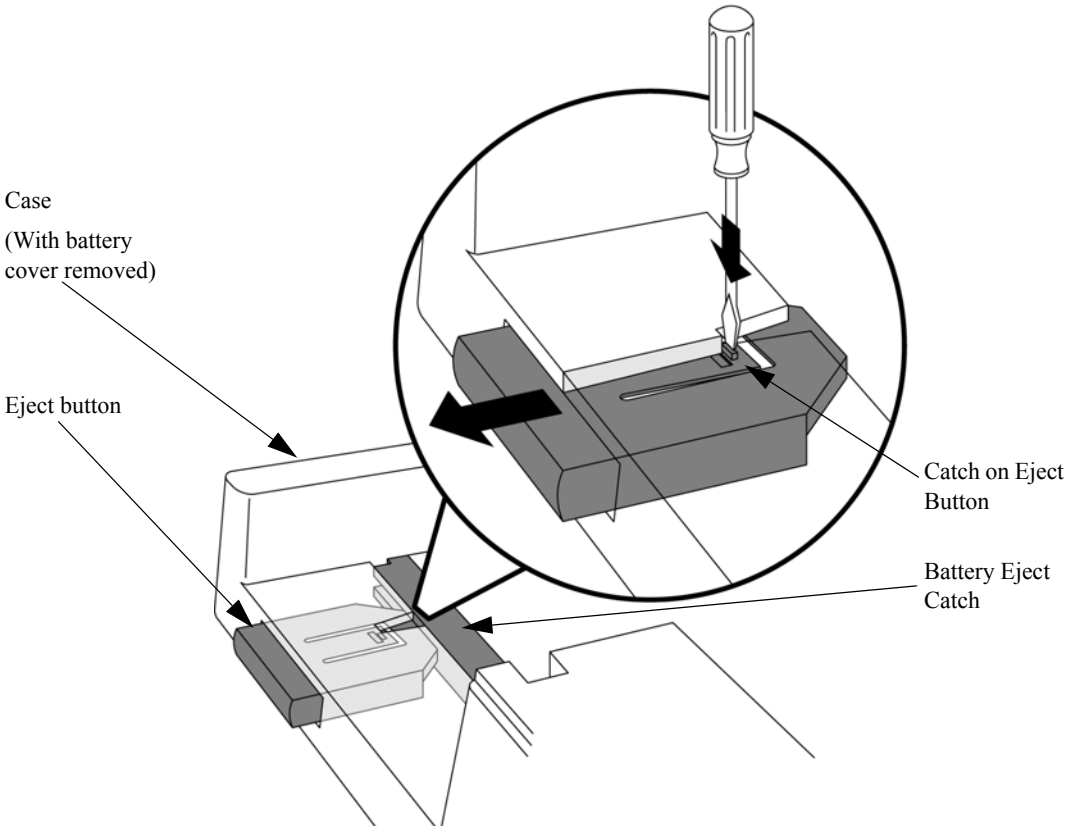
   b. Using a small, flat-bladed screwdriver, press in the catch on the Eject Button and slide the Eject Button out of the case. Note the orientation of the Eject Button. See Figure 4-6.

   TIP: The catch is located in the narrow slot in the bottom case that points to the eject button. See Figure 4-6.

3. **Remove the Battery Eject Catch.**

   Pull the Battery Eject Catch up out of its slot in the case. There will be a long spring (the Battery Catch Spring) inside the catch. Note the orientation of the Catch in its slot.

Figure 4-6 Battery Eject Mechanism



Replacement

1. **Install the Spring into the Catch.**

   Insert the new Battery Catch Spring into the hole in the end of the new Battery Eject Catch.

2. **Install the Battery Eject Catch.**

   Insert the new Battery Eject Catch into its open slot in the bottom case. Orient it so the spring points toward the Data Card Door and the triangular plastic catch faces up toward you through the open slot.

3. **Install the Battery Eject Button.**

   a. Insert the Battery Eject Button into its hole in the bottom case.

   b. Push the Eject Button all the way in to engage its catch and prevent it from falling back out. Check to be sure the Eject Button and Eject Catch slide freely and operate correctly.

4. **Replace the battery cover.**

   See "Battery Cover" on page 4-11.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Data Card Door

The following sections describe how to remove and replace the Data Card Door.

Removal

1. **Open the door.**

   This will expose the spring-loaded shaft on which the door pivots.

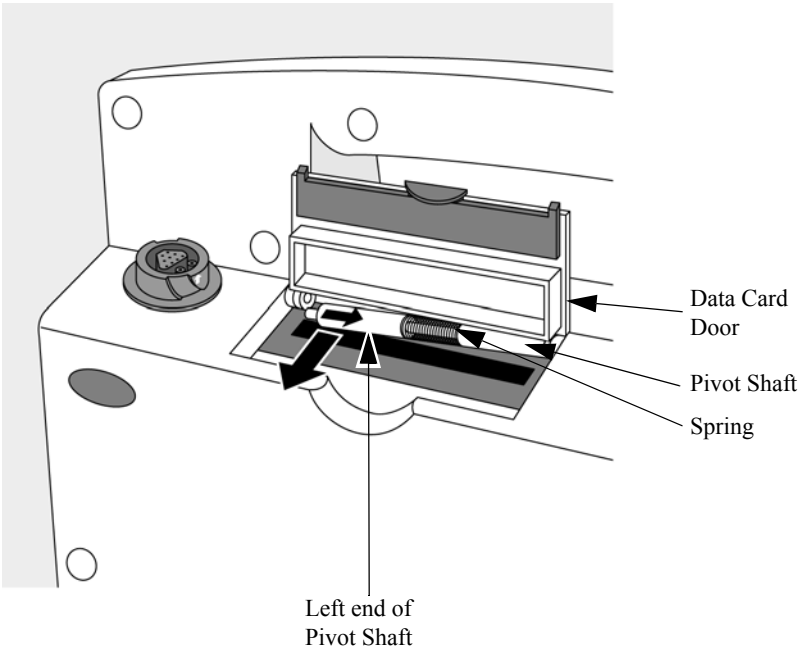
2. **Compress the shaft.**

   a. Using a small, flat-bladed screwdriver, catch the ***left*** end of the pivot shaft (not the left end of the spring) and slide it toward the center, compressing the spring.

   b. When the spring is compressed enough, the pivot shaft will pop easily out of its hole in the bottom case.

3. **Remove the door.**

Figure 4-7 Removing the Data Card Door



Replacement

1. **Check the mating holes.**

   Check to be sure the pivot holes in the case have not been damaged. If they have been, the Bottom Case Assembly must be replaced.

2. **Insert the door.**

NOTE

The new door comes complete with the black latch, the pivot shaft and the spring already installed in the door.

   a. Insert the ***right*** end of the pivot shaft into its hole in the case.

   b. Push in on the ***left*** end of the shaft to compress the spring, then slide the left end into place. Be sure the shaft snaps into position.

   c. Check to be sure the door moves freely, latches securely, and springs open when unlatched.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Energy Select Knob

The following sections describe how to remove and replace the Energy Select Knob.

Removal

Remove the Energy Select Knob.

Grasp the knob and pull straight out from the Front Bezel.

TIP: The knob will be difficult to remove. To get a better grip on the knob, try wearing rubber gloves. If needed, use a pair of pliers with soft material over the jaws.

Replacement

Replace the Energy Select Knob.

Push the knob onto the shaft. Be sure the knob is pressed fully into place. Check to be sure it rotates freely and that it points to the correct markings on the Bezel.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Paddle Holders

The following sections describe how to remove and replace the Paddle Holders.

Preparation

Remove the paddles from the holders.

Removal

1. **Remove the Paddle Holder.**
   a. Remove the 2 T15 screws.

NOTE

These ***flat head*** T15 screws are different from the ***pan head*** T15 screws used in the rest of the unit. Keep them separate and use them only for the Paddle Holder.

   b. Slide the Paddle Holder out from under the metal clip.

2. **Remove the clip.**
   a. Remove the T10 nut.
   b. Remove the clip.

Figure 4-8 Removing the Paddle Holder

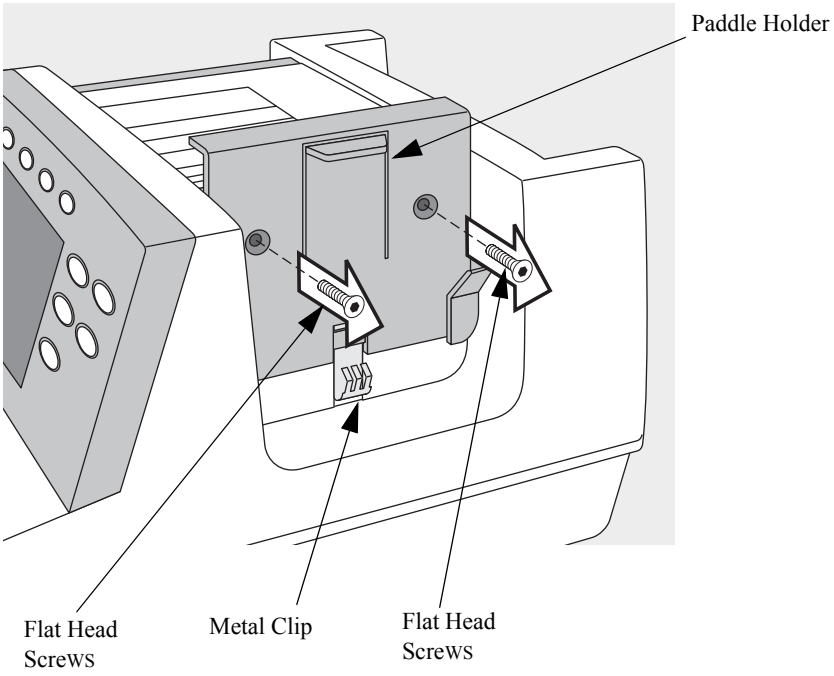
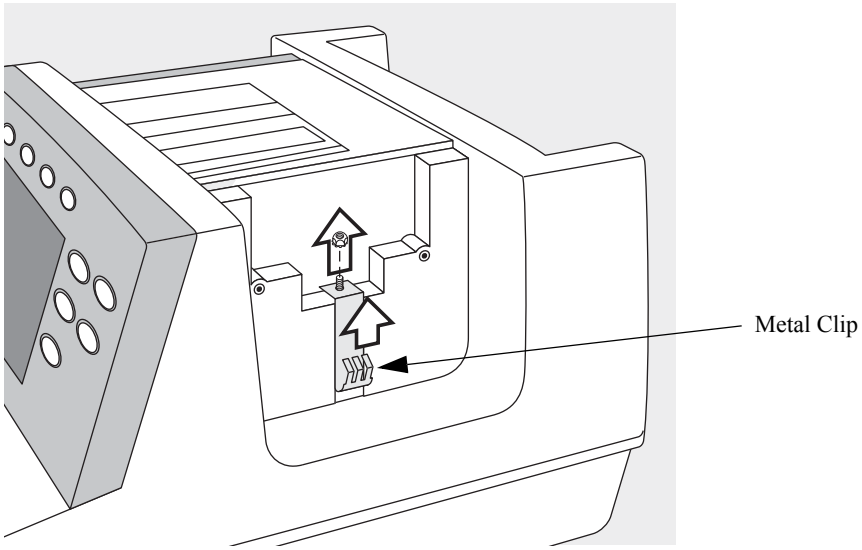


Figure 4-9 Removing the Clip



Replacement

1. **Replace the clip.**
   a. Place the clip in its slot in the case. Use the new one that came with the replacement Paddle Holder.
   b. Replace the T10 nut and tighten securely.
2. **Replace the Paddle Holder.**
   a. Slide the Paddle Holder into position under the clip.
   b. Replace the 2 T15 screws and tighten securely.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Labels

The labels used on the M4735A are divided into 4 groups:

- Instruction Label Set
- Case Label Set
- Branding Label Set
- Speaker Label.

Each set of labels is one sheet containing all the labels in that set.

The labels are adhesive-backed, and replacing a label consists of peeling up the old, cleaning the surface, and sticking down the new. See "Removing and Replacing Labels" on page 4-25.

Label Descriptions

The following sections describe each of the label sets in more detail.

Instruction Label Set

The Instruction Label Set includes one label - the label above the printer giving a brief overview of device operation.

This label comes in two versions - for units with and without the Pacing option. Each of these versions is available in all the supported languages (see Tables 5-11 and 5-12 for part numbers).

See Figure 4-10 for locations of these labels.

Case Label Set

The Case Label Set includes the following labels:

- ECG/SpO_2 Connector label (includes Warnings and Notices)
- Data Card Eject label
- Patient Connector label
- Blank label (under hole plug next to Data Card)
- Charge Battery label (on bottom of case)
- Printer label (arrow on printer sliding door)

The Case Label Set comes in two versions - for units with and without the SpO_2 monitoring option. Each of these versions is available in all the supported languages (see Tables 5-13 and 5-14 for part numbers).

See Figure 4-10 and Figure 4-11 for locations of these labels.

Figure 4-10 Instruction Label and Case Label Locations

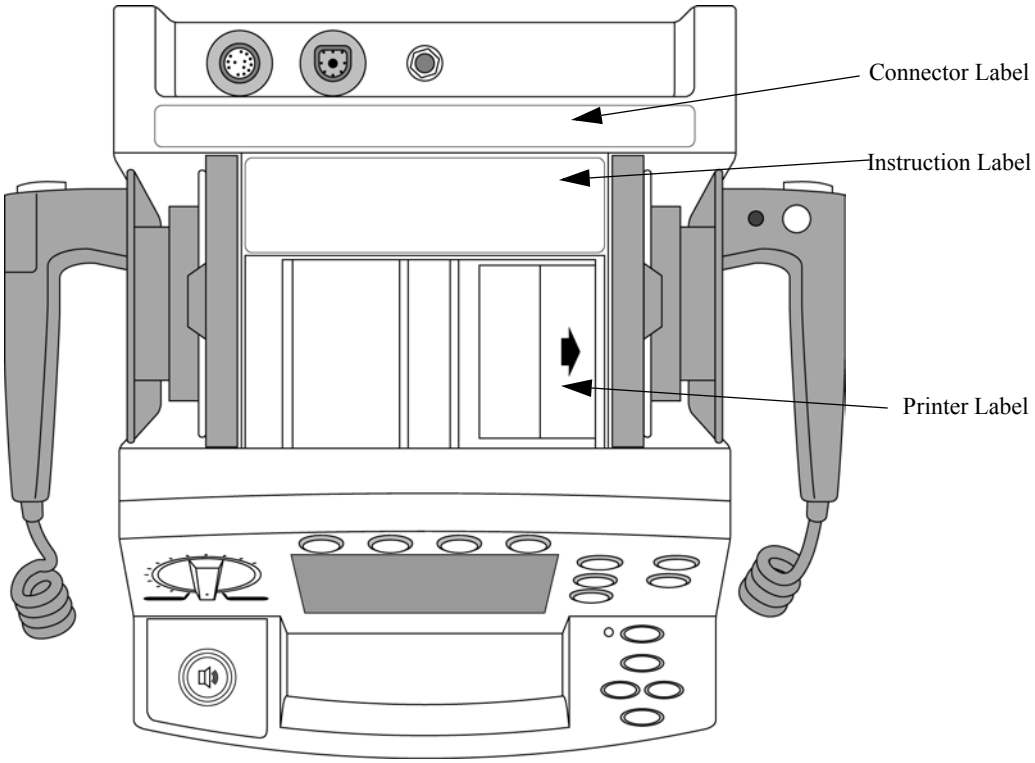
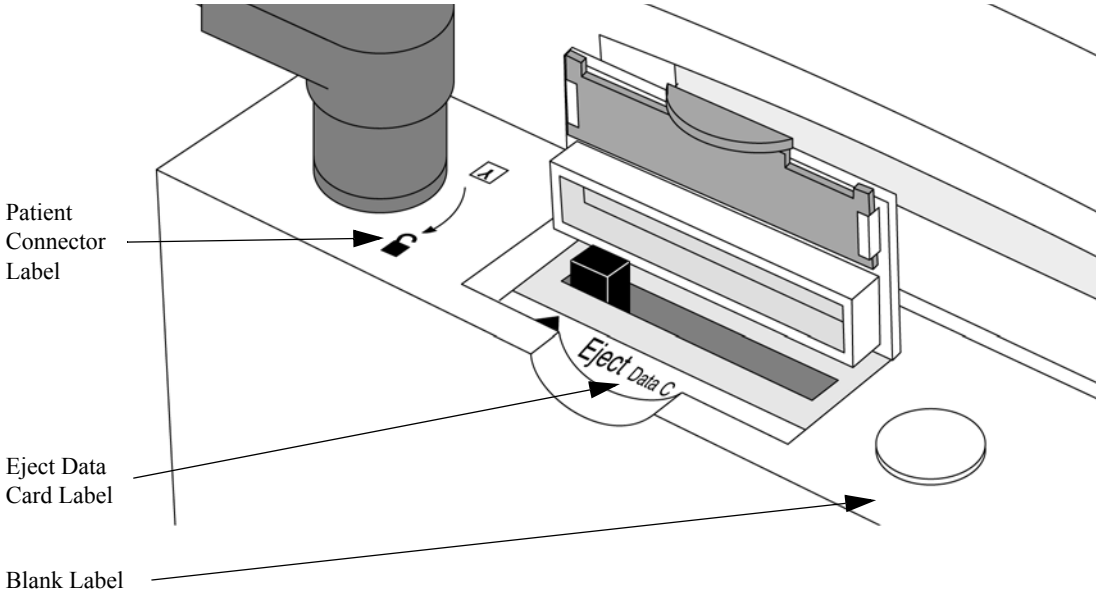


Figure 4-11 Case Label Locations



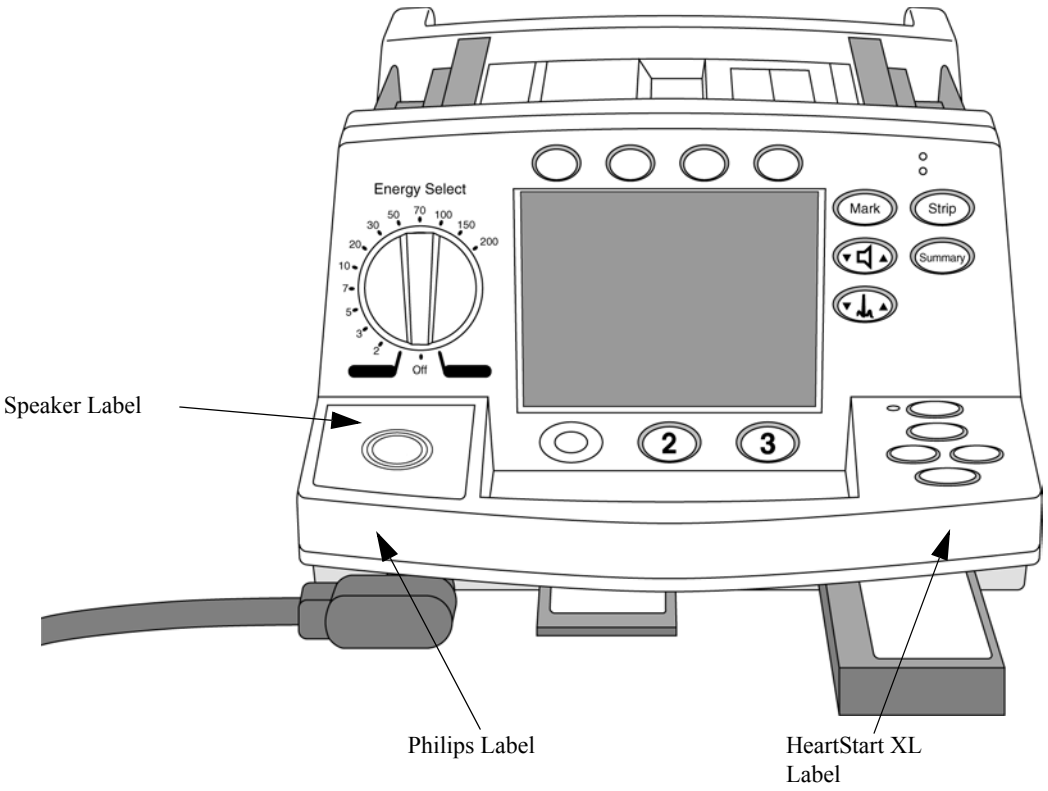
Branding Label Set

Branding labels include:

- Philips label
- HeartStart XL label

Both of these are located on the handle. They do not have language localization. See Figure 4-12 for locations.

Figure 4-12 Branding and Speaker Label Locations



Speaker Label Set

The Speaker Label covers the speaker grille, and is designed to provide good sound transmission while still protecting the speaker. The Label contains a raised circular area over the speaker. See Figure 4-12 for location.

Removing and Replacing Labels

The following sections describe how to remove and replace any of the labels.

Removal

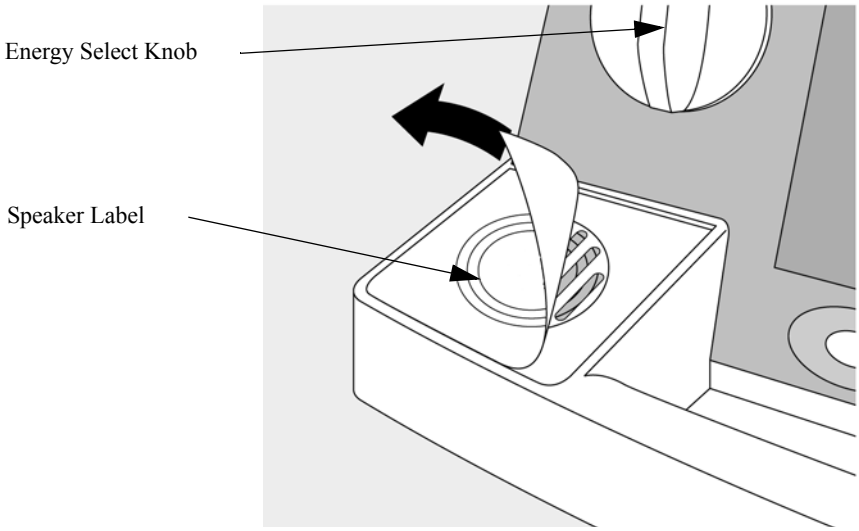
1. **Start at one corner.**

   Using a sharp tool such as a utility knife, pick up one corner of the label.

2. **Peel up the label.**

   Peel the label up by pulling slowly and evenly on the loosened corner. See Figure 4-13.

Figure 4-13 Removing the Speaker Label



Replacement

1. **Clean the surface.**

   a. Remove any adhesive residue by rubbing the dry surface with your finger and “rolling up” the adhesive residue. Solvents are ineffective, as is scraping with a tool.

   b. Clean the surface with isopropyl alcohol. Allow it to dry.

2. **Peel off the backing.**

   Peel the backing off the new label. Avoid touching the label adhesive.

3. **Apply the label.**

   a. Align one edge of the label with the recess on the case, then roll the label down slowly into position.

   b. Press firmly all over the label, especially the edges, to ensure it adheres to the case.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Opening the Case

To open the sealed case ***safely***, perform the following steps, in the order listed:

1. Discharge the Power Supply Capacitors (page 4-26).
2. Separate the Case (page 4-28).
3. Discharge the Defibrillator Capacitor (page 4-32).

Each step is described in more detail in the sections that follow.

Discharge the Power Supply Capacitors

There are two methods of discharging the unit's power supply capacitors. Always use the Primary Method first, as it will work in most cases. If there are any doubts, the Secondary Method should also be used.

CAUTION Always discharge the power supply capacitors before servicing the M4735A.

Primary Method

1. **Begin with the battery in place or the AC power connected.**

   This is necessary in order to initially charge the power supply capacitors. This charge will then power the "click" heard later.

2. **Disconnect the AC power and remove the battery.**

3. **Turn on the unit's power.**

   a. Rotate the **Energy Select** knob to turn on the power. You should hear a "click" from the speaker. If so, ***the power supply capacitors are now discharging.*** Leave the power on and ***wait at least 60 seconds*** before unplugging any internal connections.

   b. If you do ***not*** hear a click, use the Secondary Method. The power supply capacitors may not be discharged.

Secondary Method

1. **Open the case.**

   See "Separate the Case" on page 4-28. Stop after completing step 7. ***DO NOT disconnect the case halves yet***.

2. **Discharge the defibrillator capacitor**

   See "Discharge the Defibrillator Capacitor" on page 4-32. Note the condition of the Discharge Pathway.

3. **Disconnect and remove the defibrillator capacitor.**

   See "Defibrillator Capacitor" on page 4-106. Leave the foam in place on the capacitor wires.

4. **Disconnect the battery connector.**

   Unplug the 4-pin battery connector from the Power PCA. See Figure 4-14.

5. **Use the disarm resistors to discharge the power supply capacitors.**

   a. Using two clip leads, connect one clip lead to each end of one of the Disarm Resistors.

   b. Touch the other ends of the two clip leads to the two middle pins of the battery connector on the Power PCA. Maintain this connection for at least ***5 seconds***. ***The power supply capacitors are now discharged.***

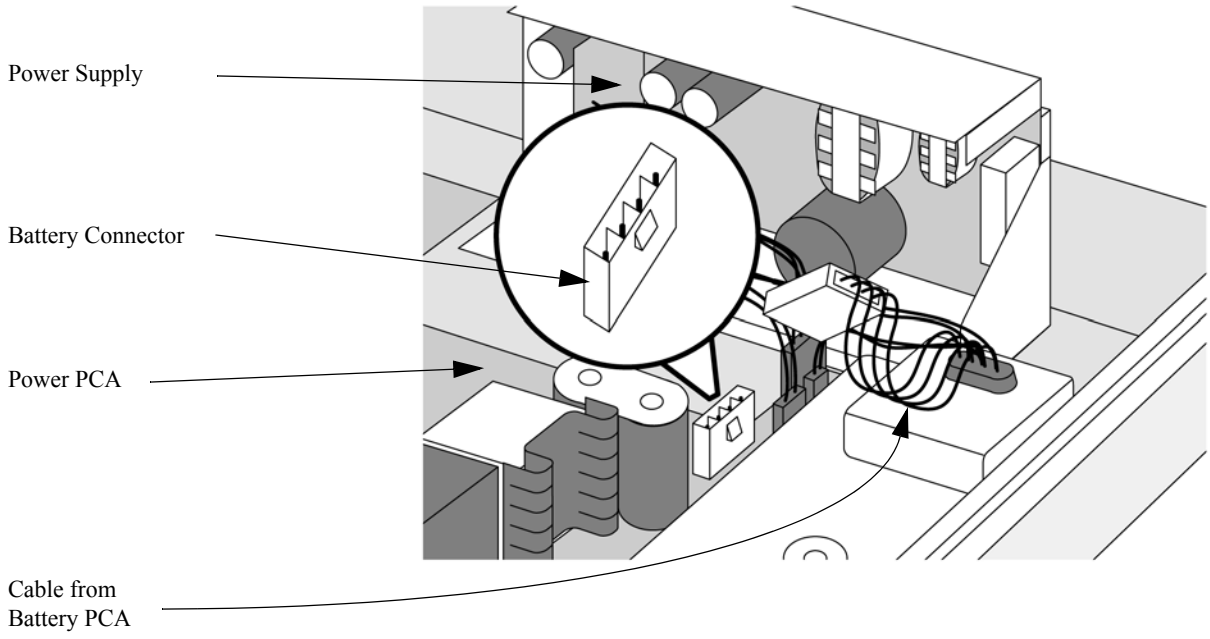
CAUTION

If the Disarm Pathway was found to be damaged in the earlier steps, repeat step 5 using the other Disarm Resistor.

6. **Disconnect the case halves.**

   See "Separate the Case" on page 4-28. Complete steps 8 and 9.

Figure 4-14 Battery Connector Location



Separate the Case

WARNING

Dangerous voltages may be present on components and connections exposed during unit disassembly. Use extreme caution while the unit cover is removed.

CAUTION

Be sure to work in a static free environment. Use an electrostatic wrist band. The work surface and area surrounding it must be static free. Use an antistatic pad which is grounded per the manufacturer's instructions.

1. **Eject the Data Card.**

   Remove the Data Card by pushing its Eject button and pulling the card out.

CAUTION

Be sure the Eject button is pushed in fully. If it is left partially extended, it can catch on the bottom case and break off.

2. **Remove the paddles.**

   Disconnect the paddles from the Patient Connector. Snap both paddles out of their retainers and lay them aside.

3. **Turn the unit over.**

   Turn the M4735A upside down (display facing down) with the handle closest to you.

4. **Remove the Battery Cover.**

   See "Battery Cover" on page 4-11.

5. **Remove the case screws.**

   a. Loosen the four T15 screws in the bottom section of the case. See Figure 4-15. **Do not remove the two screws that attach the Power Supply to the case.**

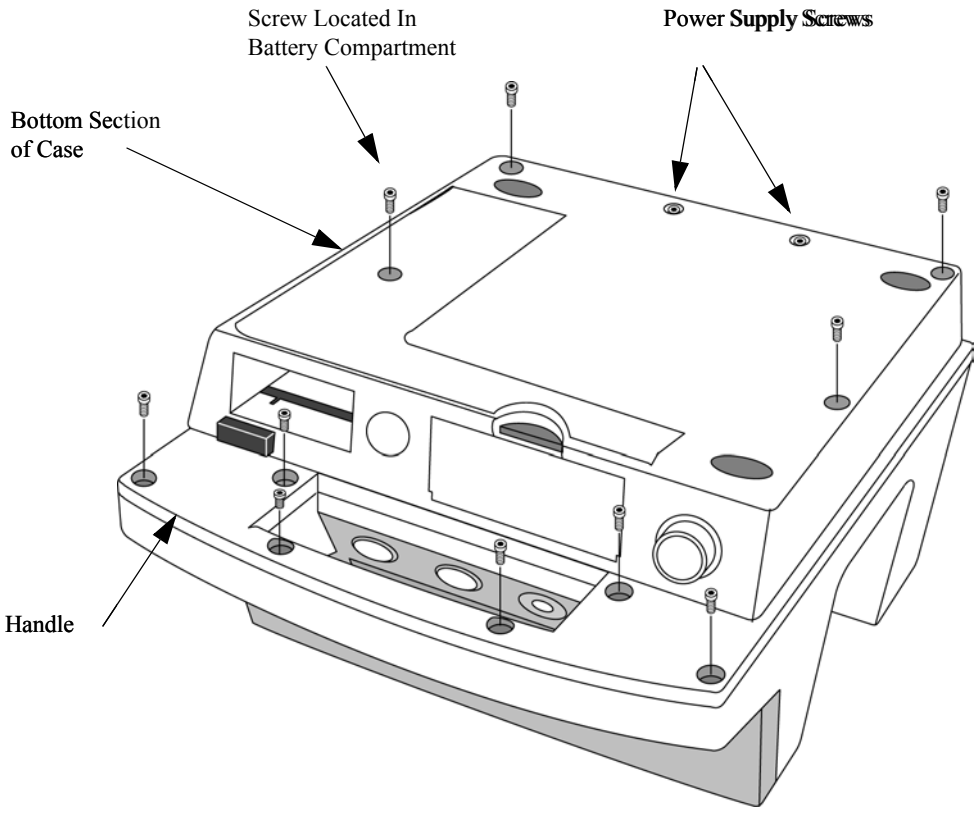
   b. Loosen the six T15 screws in the handle. Leave the two halves of the case together.

   TIP: To avoid losing any screws, apply tape over the screw holes before turning the unit rightside up.

   c. Turn the unit over rightside up (so the display is facing up). Keep the handle closest to you. The case screws will fall out of their holes as you do this.

   d. Once the screws are all out and accounted for, place the unit on the work surface rightside up.

Figure 4-15 Removing the Case Screws



6. **Open the case.**

   a. Start opening the case at the back edge to break any adhesion along the gasket.

   b. Pull the back of the top case up slightly.

   c. Then pull up the front of the top case while sliding it rearward to give the Eject button more room to clear the bottom case.

7. **Pivot the top case to a vertical position.**

   a. Once the case halves are separated, pivot the top case to the right as shown in Figure 4-16.

   b. Stop when the top case is resting on its edge, next to the bottom case.

CAUTION

Do not proceed with the next step until you are sure the power supply capacitors have been discharged. See "Discharge the Power Supply Capacitors" on page 4-26.

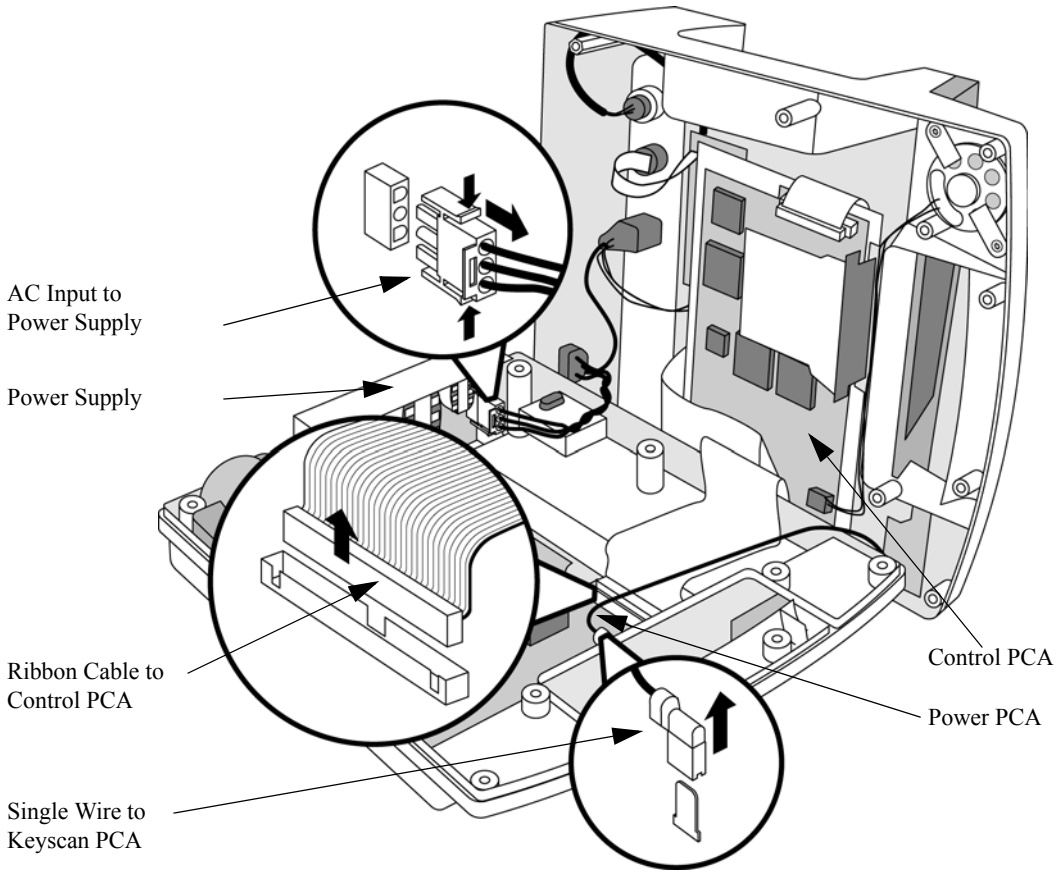
8. **Disconnect the case halves.**

   a. Disconnect the large ribbon cable from the Power PCA (connects to Control PCA).

   b. Disconnect the single wire from the Power PCA by pulling straight up with needle nose pliers (connects to Keyscan PCA).

   c. Disconnect the AC input from the Power Supply by compressing the 2 latches on the connector pulling the connector straight out from the Module.

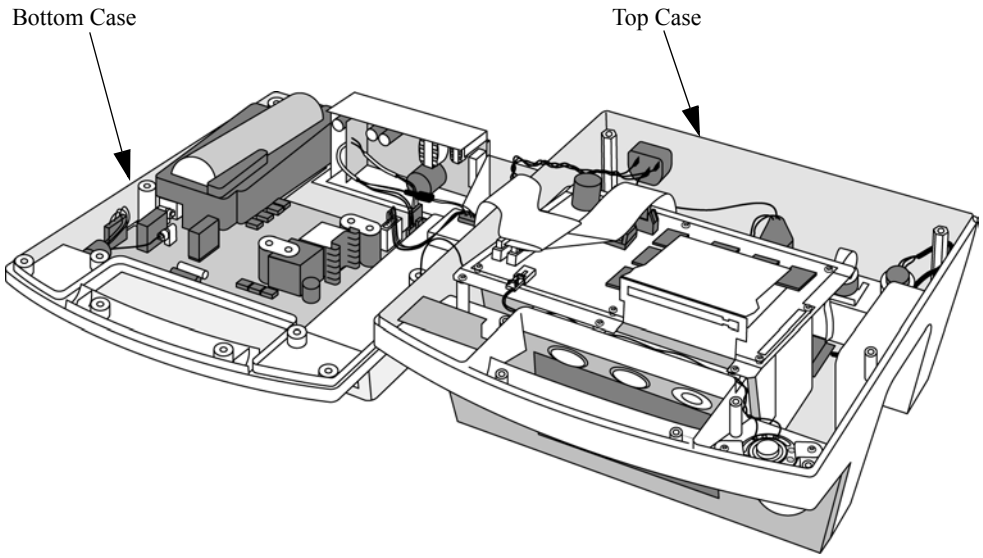
Figure 4-16 Case Opened to Vertical



9. **Lay the top case flat on the work surface.**

   Lay the top case on the work surface upside down and next to the bottom case section. See Figure 4-17.

Figure 4-17 Case Opened Flat



Discharge the Defibrillator Capacitor

The steps that follow describe how to discharging the unit's Defibrillator Capacitor.

WARNING **Always discharge the defibrillator capacitor before servicing this unit.**

WARNING **To avoid completing a high voltage circuit, use only one hand to perform the following steps. Keep the other hand away from the unit at all times. Touch only the parts described.**

1. **Lift the capacitor out of the way.**

   Lift up the defibrillator capacitor together with its foam base. Lift straight up, then turn the capacitor to the right and rest it on the Power PCA. See Figure 4-18.

2. **Inspect the Disarm Pathway.**

   Look for signs of arcing, burning, damage to the resistors or inductor, blown traces on the Power PCA, etc.

   TIP: The Disarm Pathway is located under the Defibrillator Capacitor on the left side of the Power PCA. The Disarm Pathway consists of two large power resistors (Disarm Resistors), a red inductor, and the PCA traces that connect them. See Figure 4-18.

3. **Choose a discharge method.**

   - If the Disarm Pathway is intact, refer to See Figure 4-18 on page 4-33. and use the ***Primary Method*** below to discharge the defibrillator capacitor.
   - If you see any burns or damage, the Disarm Pathway ***may not be intact***. Use the ***Primary Method***, then also use the ***Secondary Method*** to discharge the defibrillator capacitor.

Primary Method

a. Using the High Voltage Discharge Tool, first touch one end of the tool's brass bar to the current sensing resistor (the small loop of flat metal). See See Figure 4-18 on page 4-33.

b. Then pivot the brass bar so its other end contacts the exposed end of the disarm resistor.

c. Maintain contact at these two points for at least 5 seconds. ***The defibrillator capacitor is now discharged.***

Secondary Method

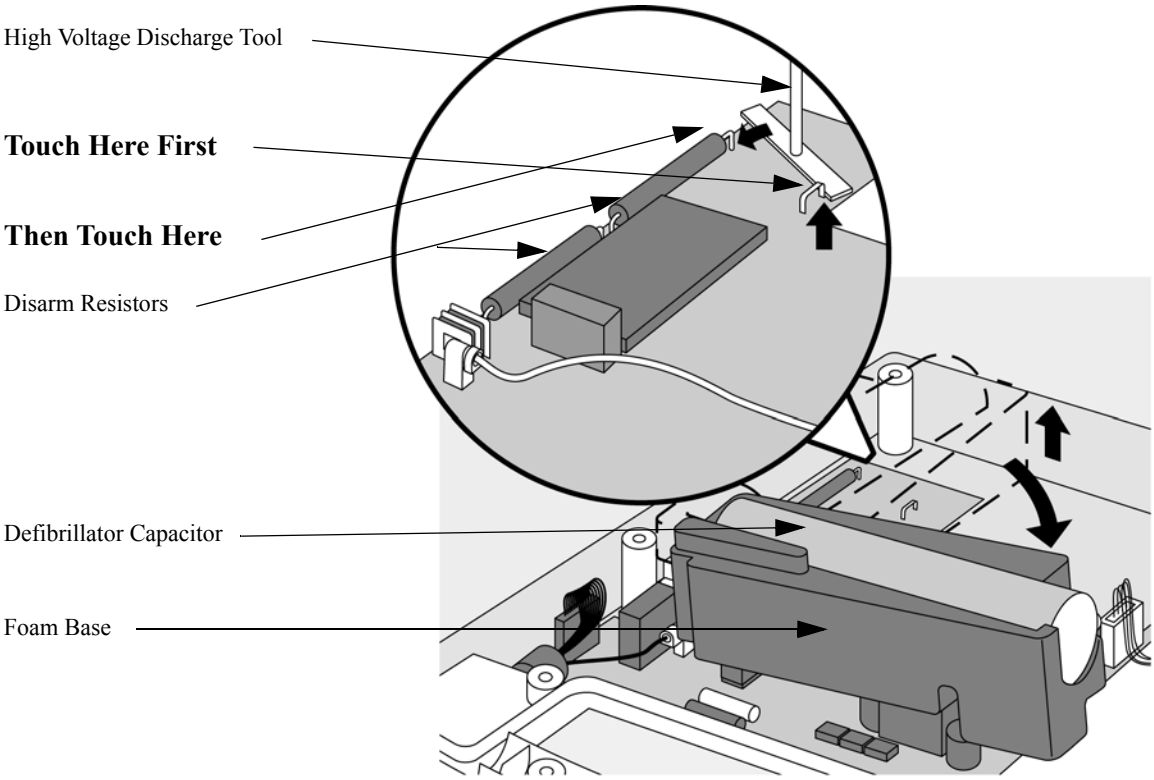
a. Using two clip leads, connect one clip lead to each end of one of the Disarm Resistors.

b. Touch the clip leads directly to the spade terminals on the Power PCA where the Defibrillator Capacitor is connected. Maintain this connection for at least 5 seconds.

TIP: Another way to make this connection is to clip the leads to test probe leads, then use the test probes to touch the spade terminals.

c. Repeat steps a and b using the other Disarm Resistor. ***The defibrillator capacitor is now discharged, even if one of the resistors is damaged.***

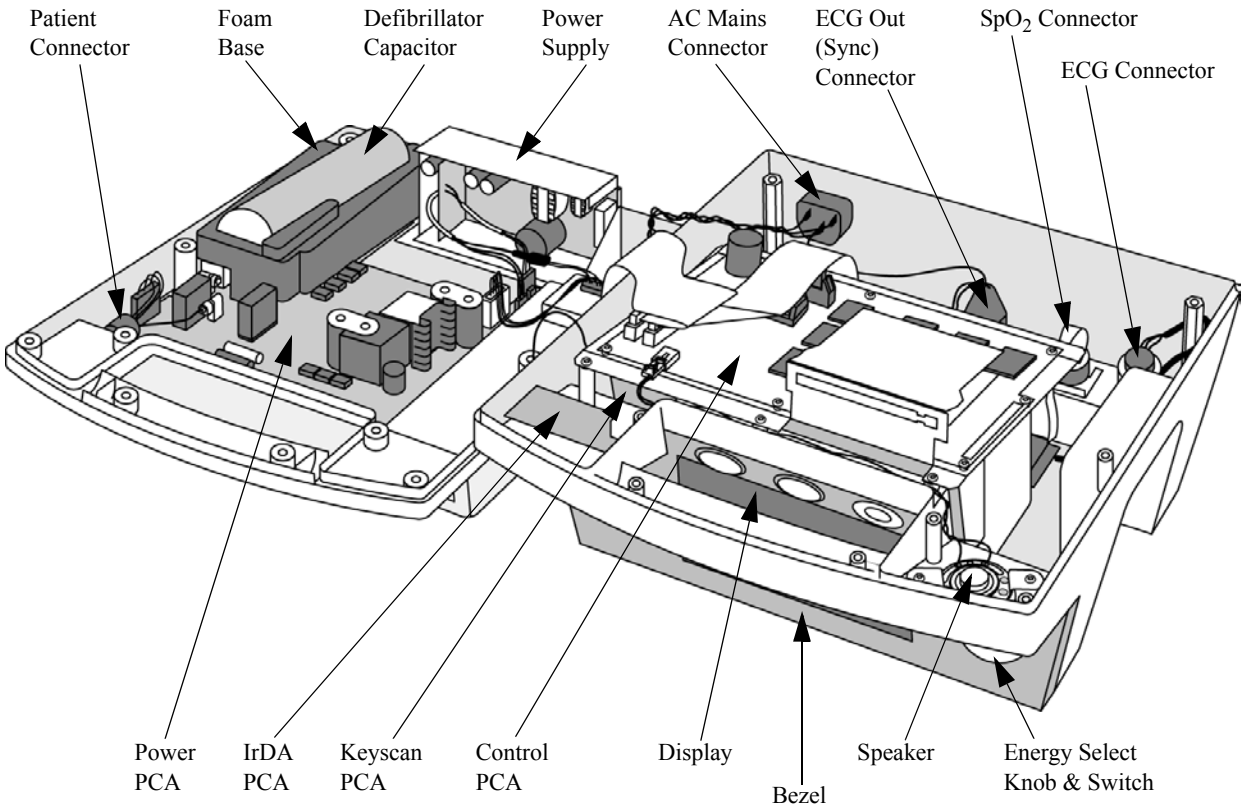
Figure 4-18 Discharging the Defibrillator Capacitor



Identifying Internal Subassemblies

Refer to Figure 4-19 to identify the internal subassemblies.

Figure 4-19 Internal Subassemblies



Internal Assemblies – Top Case

This section provides instructions for removing and replacing assemblies found in the top case. These assemblies include:

Lithium Backup Battery

The Lithium Battery maintains the unit's stored information on the Control PCA when the main battery is removed or depleted. A cable tie wrap and a package of ProGold wipes are included in the Lithium Battery replacement kit. Make sure that you clean the contact clips and new battery terminals with a ProGold wipe and replace the cable tie wrap that holds the battery in place. See Table 5-5 on page 5-8 for the replacement kit part number.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

Removal

Remove the existing battery.

a. Using a pair of fine nose wire cutters, cut and remove the cable tie wrap that holds the battery in place. See Figure 4-20 and Figure 4-21 for location.

b. Remove the battery from the holder.

Cleaning

a. Thoroughly clean the contact clips and new battery terminals with a ProGold wipe.

Replacement

Install the new Lithium battery.

a. Insert the battery into the holder.

CAUTION

Be sure to install the new battery with the correct orientation. Follow the polarity markings on the bottom of the battery holder (under the battery).

b. Secure it in place with a new cable tie wrap.

After Repair

After the repair is complete, perform the following steps.

1. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

3. **Restore the system configuration.**

   Use the Language Support Tool to restore the unit's serial number and to select whether SpO_2 hardware is installed or not. See "The Language Support Tool" on page 2-12.

4. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Control PCA

The steps below describe how to remove and replace the Control PCA. The Control PCA contains the unit's operating software, including the data for the voice prompts. All Control PCAs are American English, part number 453564058111. Installing a new Control PCA requires the use of the Language Support Tool to set the Control PCA to the correct language. See Table 5-2 on page 5-6 for part numbers.

NOTE

Simply removing and replacing the existing Control PCA does ***not*** require the Language Support Tool.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal

1. **Disconnect the Control PCA (Five Cables).**

   a. Disconnect the large ribbon cable on the left side of the Control PCA (connects to the Power PCA). See Figure 4-20 on page 4-39.

   b. Disconnect the smaller ribbon cable on the left side of the Control PCA (connects to the Parameter PCA).

   c. Disconnect the small ribbon cable at the rear of the PCA (connects to the printer). This requires releasing latches on the ends of connector. Push the latches out and down to release them.

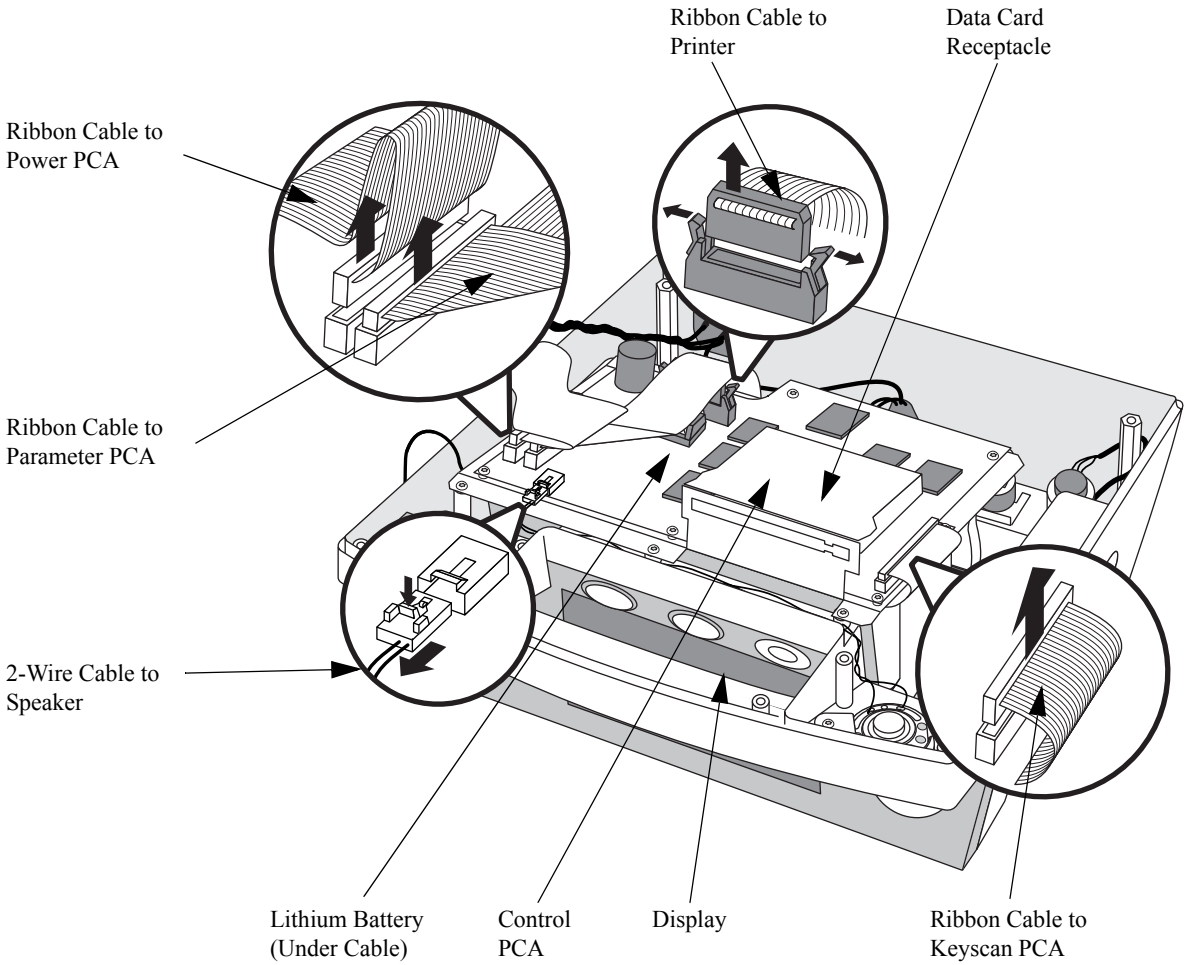
   d. Disconnect the small 2-wire connector at the front edge of the PCA (connects to the speaker). This connector has a latch on the top. Push down on the latch to release it and wiggle the connector side to side to pull it out.

   e. Disconnect the large ribbon cable on the right side of the Control PCA (connects to the Keyscan PCA).

NOTE

Older versions of Control PCA and Shield Plate may look slightly different. The appearance does not affect the repair and upgrade procedures.

Figure 4-20 Control PCA Connections



2. **Remove the screws.**

   a. Remove the eight screws around the edges of the Control PCA. See Figure 4-21.

   b. Remove the one screw near the center of the PCA. ***Be careful not to damage any nearby components or traces.***

3. **Remove the Control PCA.**

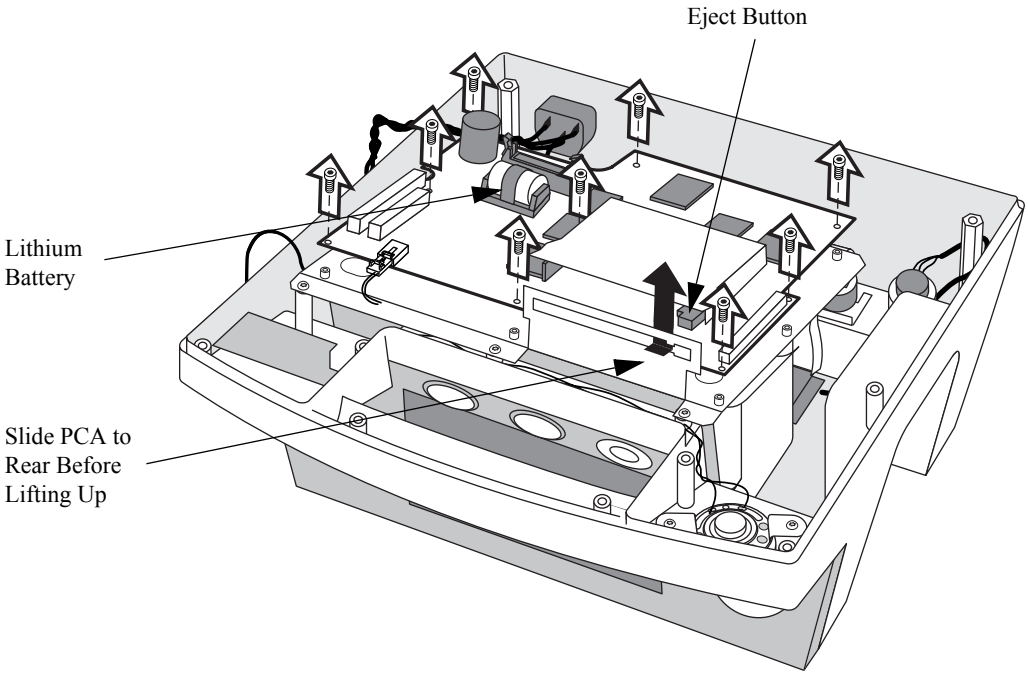
   a. Move the Control PCA toward the rear while lifting it off the metal shield plate. This will help the Eject button clear its hole in the black plastic shield surrounding the Data Card receptacle.

NOTE

If the black plastic shield is damaged, remove it; otherwise leave it in place on the metal shield plate. If you are replacing the Control PCA, the new PCA comes with a new plastic shield.

   b. Leave the lithium backup battery in place when returning the PCA for repair. This will help preserve information for factory troubleshooting.

Figure 4-21 Control PCA Screws



Replacement

1. **Place the Control PCA in position.**

   Line up the holes in the Control PCA with the threaded standoffs on the shield plate. Lower the PCA straight down into position.

CAUTION Do not drag the PCA over the surface of the shield plate to align it.

2. **Replace the screws.**

   TIP: Screw installation is easier if all screws are started in their holes before any one of them is tightened.

3. **Connect the Control PCA.**

   a. Connect the speaker cable.

   b. Connect the printer cable.

   c. Connect the ribbon from the Parameter PCA.

   d. Connect the ribbon from the Keyscan PCA.

4. **Replace the plastic shield, if needed.**

   If the black plastic shield was damaged earlier, replace it now with the one provided with the new Control PCA. Remove any remaining pieces of the old shield, peel the backing paper from the new shield, and press firmly to adhere the shield into place.

After Repair

After the repair is complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the system configuration.**

   Use the Language Support Tool to set the Control PCA to the correct language, to restore the unit's serial number, and to select whether SpO_2 hardware is installed or not. See "The Language Support Tool" on page 2-12.

3. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Shield Plate

The sections below describe how to remove and replace the metal Shield Plate located under the Control PCA. This procedure is often needed when removing and replacing other assemblies.

Preparation

Disconnect and remove the Control PCA.

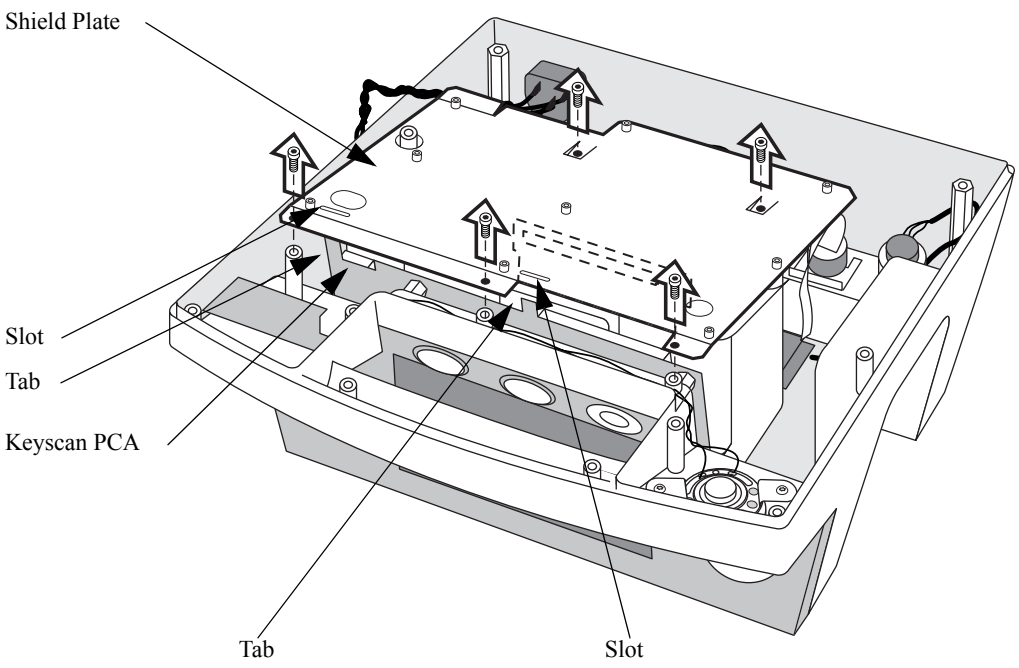
See "Control PCA" on page 4-38.

Removal

a. Remove the five screws around the edges of the shield plate. See Figure 4-22.

b. Lift the plate straight up.

Figure 4-22 Removing the Shield Plate



Replacement

a. Lower the plate into place. Be sure to engage the tabs on the Keyscan PCA into the mating slots in the Shield Plate.

b. Replace the five screws.

TIP: Screw installation is easier if all screws are started in their holes before any one of them is tightened.

Keyscan PCA (EL Display)

There are two versions of the Keyscan PCA, depending what type of Display the device has. See "Identifying the Display Type" on page 5-7 for information. Follow the procedures that match your device.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Note the serial number of the device.**

   You will need this number when performing the removal and replacement procedures.

3. **Open the case safely.**

   See "Opening the Case" on page 4-26.

4. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

5. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-42.

Removal

1. **Disconnect the Keyscan PCA (12 cables).**

   TIP: Position the M4735A with its handle hanging off the edge of your work surface. See Figure 4-23.

   a. Remove the large ribbon cable. Its other end has already been disconnected from the Control PCA. Note the position and location of the bend in the ribbon cable.

   b. Note that two flex circuits (to the Pacing Keypad) are routed around the top edge of the Keyscan PCA, and two flex circuits (to the Main Keypad) are routed around the lower edge of the Keyscan PCA.

NOTE

If you have a device with serial number US002XXXXX or US003XXXXX, a ferrite will be attached to each flex circuit and a metal bracket will be attached to the Main Keypad flex circuit. **Save the ferrites and the metal bracket as you will need to install these on the replacement Keyscan PCA.**

   c. Disconnect the two pacing keypad flex circuits, if installed. Unlatch the white receptacles on the PCA by pulling upward on the top of the receptacle, then slide out the flex circuit.

d. If your device has a metal bracket, remove the T10 screw and nut. Hold the nut in place with needle nose pliers so it doesn't fall into the case.

e. Disconnect the two main keypad flex circuits and remove the metal bracket.

f. Disconnect the IrDA break-off PCA. Press on the connector latch to release it.

g. Disconnect the Energy Select Switch. Press on the connector latch to release it.

h. Disconnect the two display ribbon cables. The larger ribbon connector has latches on the ends of the connector; press them out and down to release the connector. The smaller connector has no latch - wiggle ***gently*** from side to side while pulling it out.

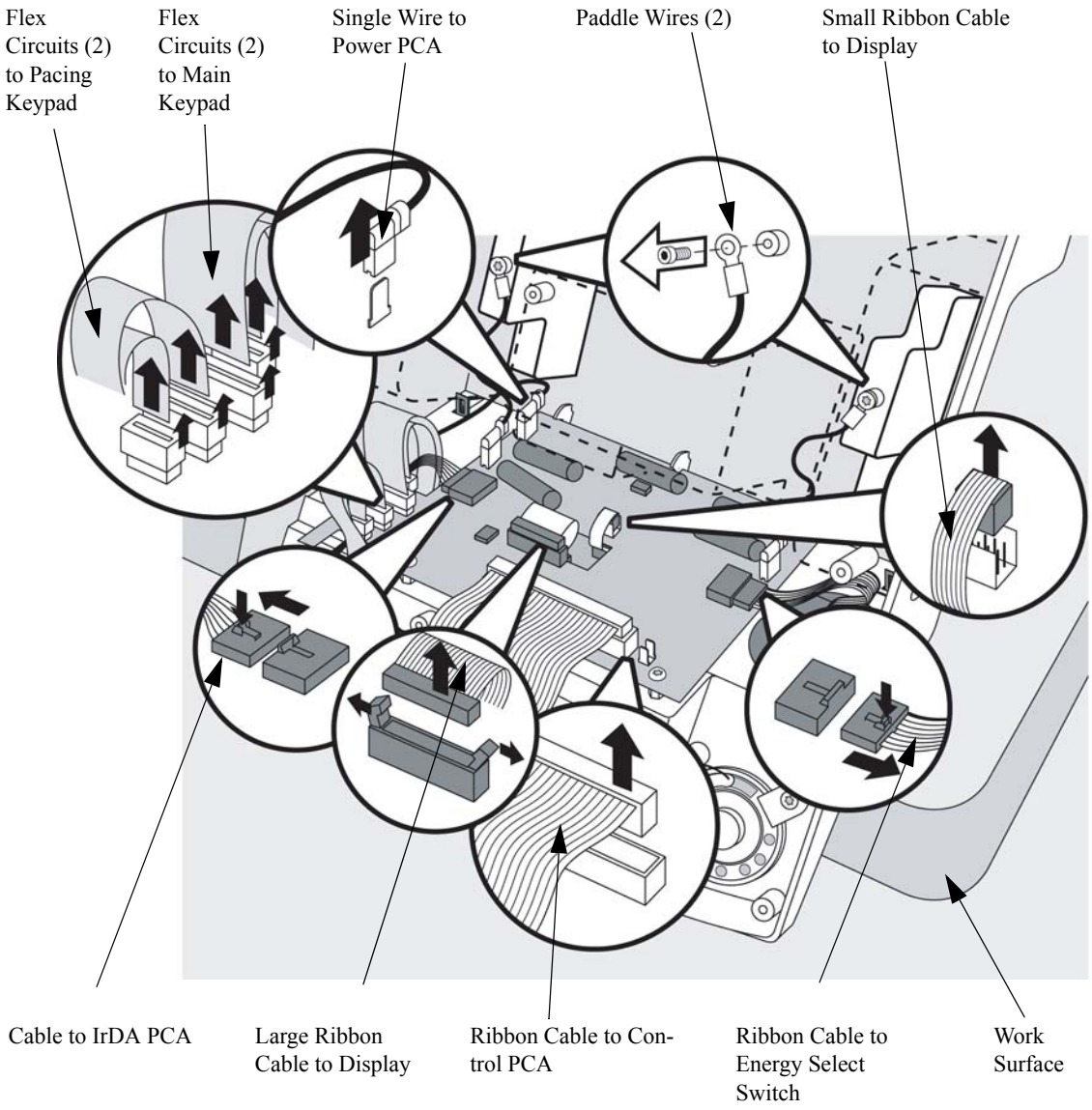
TIP: If the Keyscan PCA is being removed to get access to the Front Bezel or the Display, don't disconnect the paddle wires - after unscrewing the two screws (step 2 below), flip the PCA over and lay it ***component side down*** on the underside of the Printer bucket.

i. Disconnect the two paddle wires. Remove the T10 screws that connect them to the threaded inserts under the paddle holders. For now leave the wires connected to the spade connectors on the PCA.

NOTE

These T10 screws are a ***different length*** than the T10 screws used in the rest of the unit. Keep them separate by screwing them back into the threaded inserts by hand, and leaving them there until needed.

Figure 4-23 Keyscan PCA Connections for Devices with an EL Display



2. **Unscrew and remove the Keyscan PCA.**

   a. Unscrew the two T10 screws located at the edge of the PCA nearest you; they attach the PCA to the threaded standoffs. Be sure to unscrew just the screws and not the standoffs.

   b. Lift the Keyscan PCA out of the case and lay it component side up on a static-safe surface.

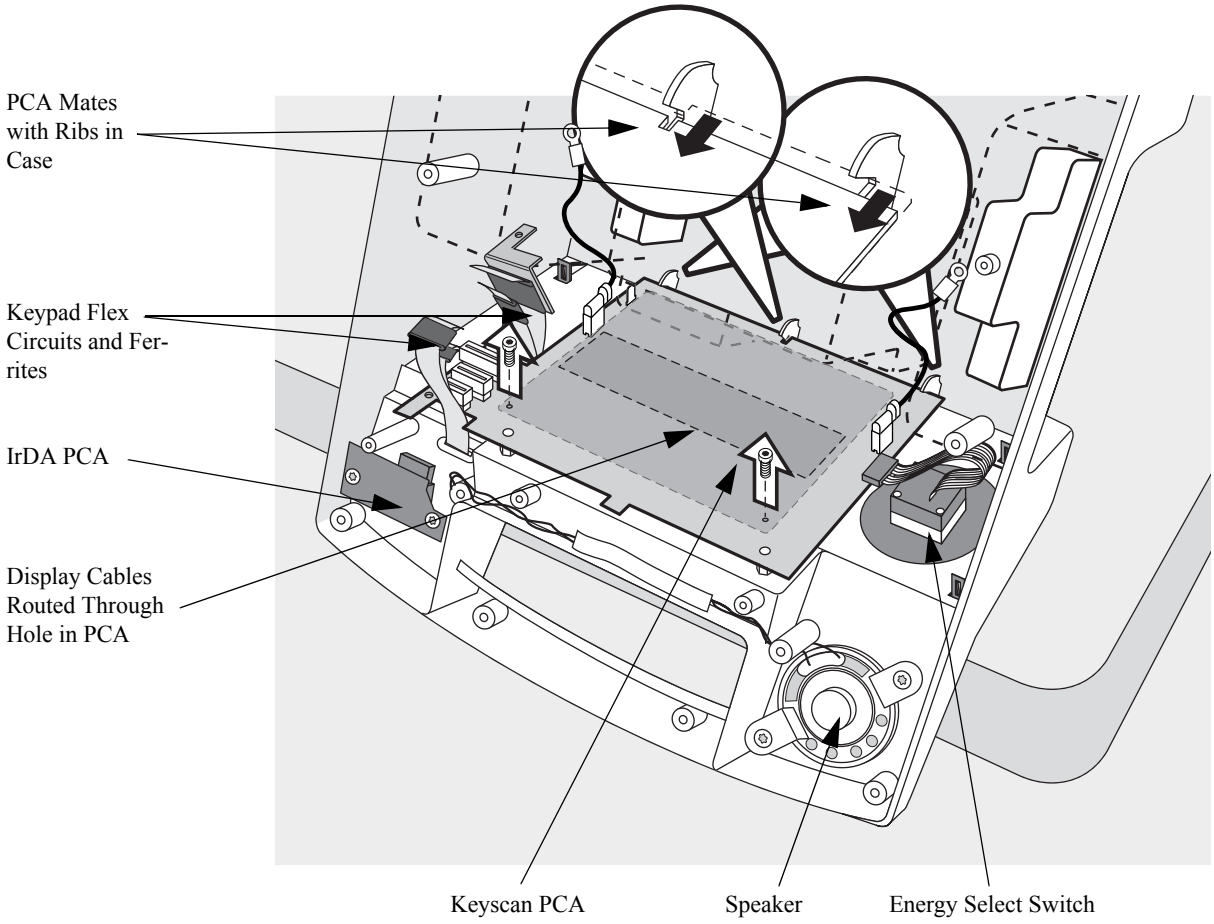
3. **Remove the three individual wires.**

   a. Pull straight up with a needle nose pliers to disconnect the two paddles wires. Their other ends have already been disconnected from the paddles pockets.

   TIP: Wiggling the spade connectors will help, but use care to not bend the PCA-mounted connections.

   b. Pull straight up with a needle nose pliers to disconnect the one remaining wire. Its other end has already been disconnected from the Power PCA.

Figure 4-24 Keyscan PCA Screws



4. **Unscrew and remove the IrDA break-off PCA. (OPTIONAL)**

   If the Keyscan PCA is being replaced, also remove the IrDA PCA. A replacement IrDA PCA is provided with the replacement Keyscan PCA.

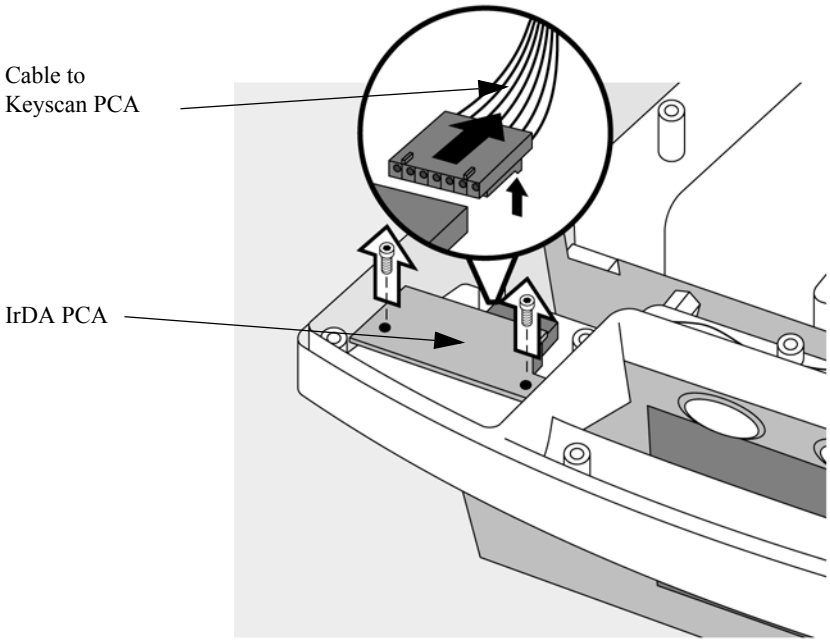
   If the Keyscan PCA is being removed for access to other subassemblies, skip this step.

   a. Remove the two T10 screws that attach the IrDA PCA to the case. See Figure 4-25.

   b. Remove the PCA.

   c. Disconnect the cable from the PCA. Press on the connector latch to release it. Its other end has already been disconnected from the Keyscan PCA.

Figure 4-25 Removing the IrDA PCA



Replacement

1. **Replace the IrDA break-off PCA.**

   If the IrDA PCA was removed, replace it now.

   a. Connect the cable to the IrDA PCA.

   b. Place the IrDA PCA in position inside the top case.

   c. Replace the two screws.

2. **Connect the three individual wires to the Keyscan PCA.**

   a. Connect the longest wire to the spade connector at the lower left edge of the PCA. This wire has spade receptacles on both ends.

   b. Connect the other two wires to the spade connectors at opposite side edges of the PCA (on either end of the power resistors). These wires have ring terminals on their other ends.

3. **Install the Keyscan PCA.**

   a. Align the bottom edge of the PCA with the mating slots in the case. Note that there is also a slot in the PCA which must line up with a rib on the case. See Figure 4-24.

   b. As you lay the PCA against the threaded standoffs, guide the two display ribbon cables through the window in the Keyscan PCA.

   c. Replace the two T10 screws and tighten.

4. **Reconnect the Keyscan PCA.**

   a. Connect the two paddle wires to the paddles pockets. Replace the two T10 screws and tighten.

   b. Connect the two display ribbon cables. Latch the larger one in position. Be sure the smaller one is fully inserted in its connection.

   c. If you removed the Energy Select Switch, replace it and connect it to the Keyscan PCA. Be sure the connector latches into position securely.

   d. Connect the IrDA break-off PCA.

   e. For devices with serial number US002XXXXX or US003XXXXX, place the ferrites on the two pacing keypad flex circuits.

   f. Route the flex circuits as they originally were, with two above and two below the Keyscan PCA.

   g. Connect the two pacing keypad flex circuits. Have the latching top of the connector up; then slide the flex circuit into place and push the top down to latch it. Reposition the ferrites, as shown in Figure 4-26.

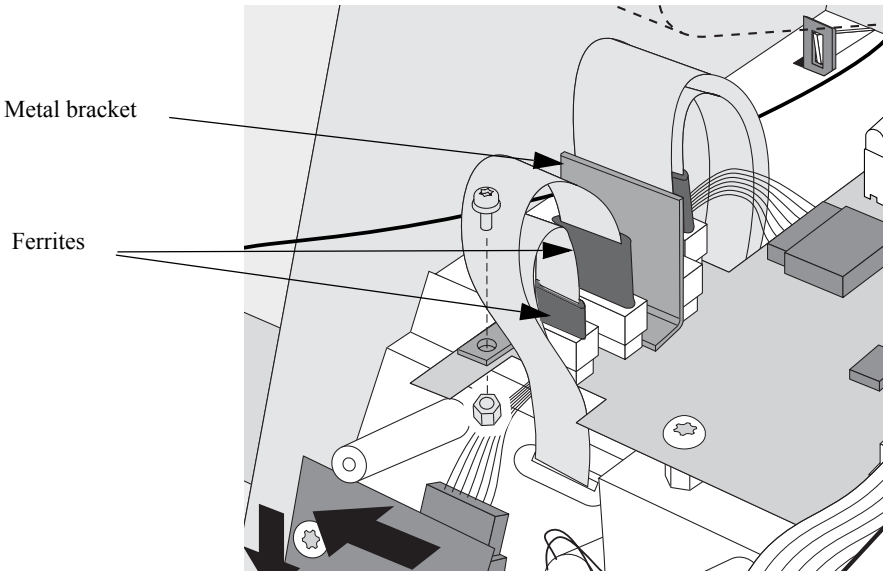
h. For devices with serial number US002XXXXX or US003XXXXX, place the ferrite on the small main keypad flex circuit. Place the metal bracket with the attached ferrite on the large keypad flex circuit.

i. Connect the small main keypad flex circuit. Have the latching top of the connector up; then slide the flex circuit into place and push the top down to latch it. Reposition the ferrite, as shown in Figure 4-26.

j. Connect the large keypad flex circuit. Guide the metal bracket into place while sliding the flex circuit in. Push the top of the connector down to latch it.

k. Secure the bracket by placing the T10 screw into place. Hold the nut in place with your finger or needle nose pliers while tightening the screw.

Figure 4-26 Ferrites and Metal Bracket Placement



NOTE If the Pacing option is not installed, there will be only two flex circuits.

l. Connect the large ribbon cable, keeping its orientation and bending as it was originally.

After Repair

After the repair is complete, perform the following steps.

1. **Replace the Shield Plate.**

   See "Shield Plate" on page 4-42.

2. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

3. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

4. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Keyscan PCA (LCD Display)

There are two versions of the Keyscan PCA, depending what type of Display the device has. See "Identifying the Display Type" on page 5-7 for information. Follow the procedures that match your device.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Note the serial number of the device.**

   You will need this number when performing the removal and replacement procedures.

3. **Open the case safely.**

   See "Opening the Case" on page 4-26.

4. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

5. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-42.

Removal

1. **Disconnect the Keyscan PCA (12 cables).**

   TIP: Position the M4735A with its handle hanging off the edge of your work surface. See Figure 4-27.

   a. Remove the large ribbon cable. Its other end has already been disconnected from the Control PCA. Note the position and location of the bend in the ribbon cable.

   b. Note that two flex circuits (to the Pacing Keypad) are routed around the top edge of the Keyscan PCA, and two flex circuits (to the Main Keypad) are routed around the lower edge of the Keyscan PCA.

   c. Disconnect the two pacing keypad flex circuits, if installed. Unlatch the white receptacles on the PCA by pulling upward on the top of the receptacle, then slide out the flex circuit.

   d. Disconnect the two main keypad flex circuits.

   e. Disconnect the IrDA break-off PCA. Press on the connector latch to release it.

   f. Disconnect the Energy Select Switch. Press on the connector latch to release it.

g. Disconnect the display spade connector by pulling straight up with a needle nose pliers.

TIP: If the Keyscan PCA is being removed to get access to the Front Bezel or the Display, don't disconnect the paddle wires - after unscrewing the two screws (step 2 below), flip the PCA over and lay it ***component side down*** on the underside of the Printer bucket.

h. Disconnect the two paddle wires. Remove the T10 screws that connect them to the threaded inserts under the paddle holders. For now leave the wires connected to the spade connectors on the PCA.

NOTE

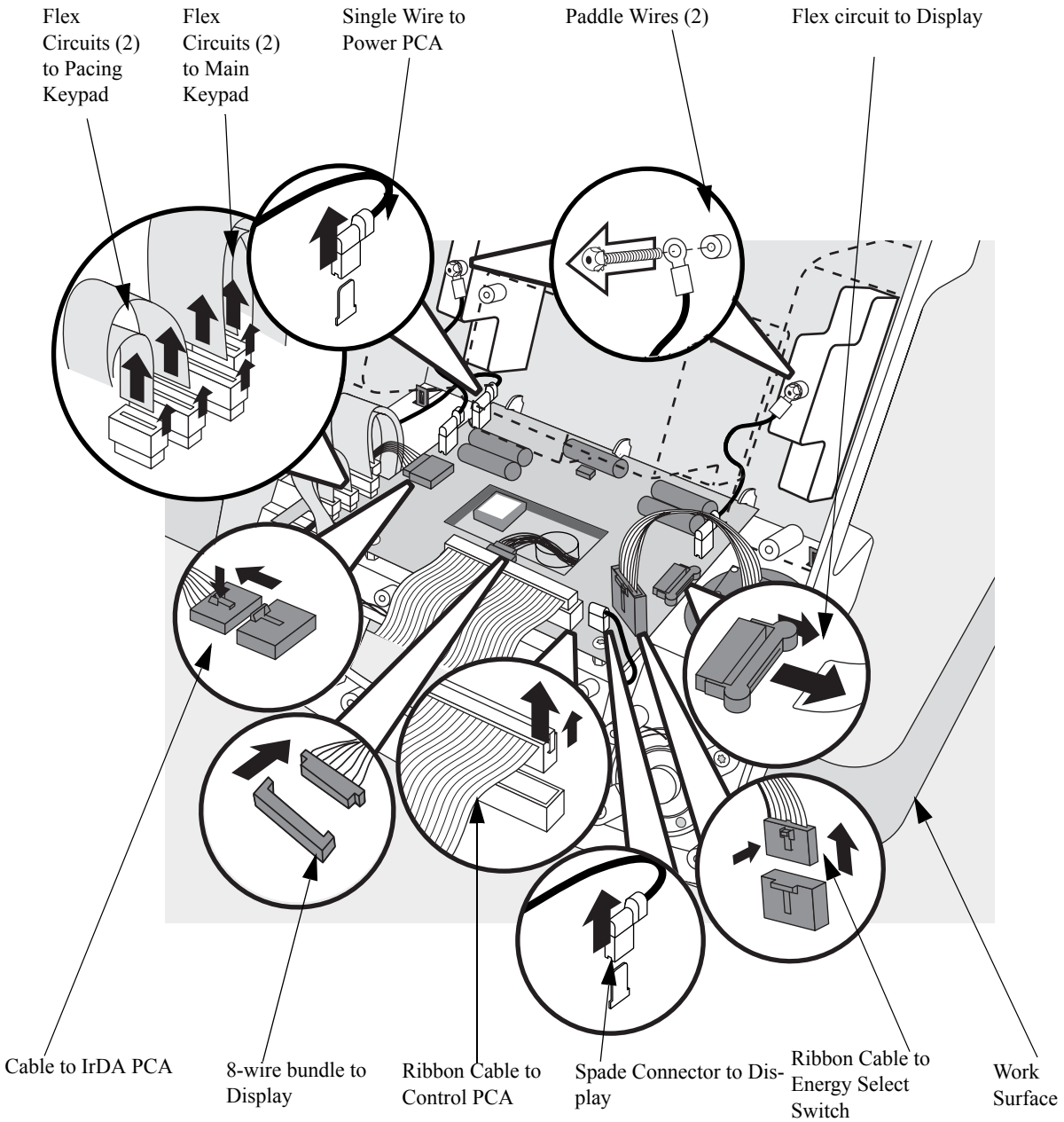
These T10 screws are a ***different length*** than the T10 screws used in the rest of the unit. Keep them separate by screwing them back into the threaded inserts by hand, and leaving them there until needed.

i. Disconnect the display 8-wire bundle by gently pushing on the latch and pulling straight out.

TIP: You may find it easier to remove the Energy Select Switch to gain access to the display flex circuit.

j. Disconnect the display flex circuit by pulling up on the latch to release it and pulling out.

Figure 4-27 Keyscan PCA Connections for Devices with an LCD Display



2. **Unscrew and remove the Keyscan PCA.**

   a. Unscrew the two T10 screws located at the edge of the PCA nearest you; they attach the PCA to the threaded standoffs. Be sure to unscrew just the screws and not the standoffs.

   b. Lift the Keyscan PCA out of the case and lay it component side up on a static-safe surface.

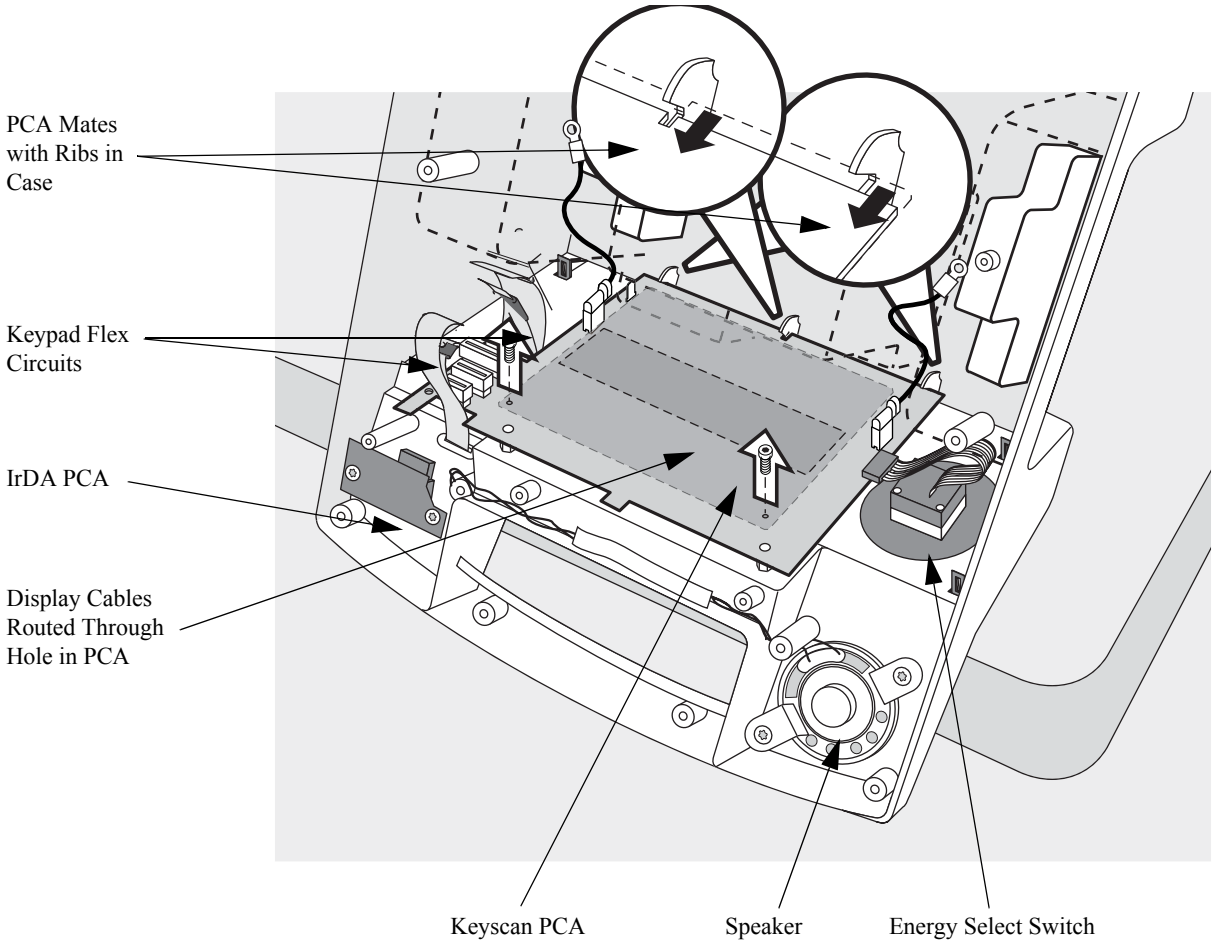
3. **Remove the three individual wires.**

   a. Pull straight up with a needle nose pliers to disconnect the two paddles wires. Their other ends have already been disconnected from the paddles pockets.

   TIP: Wiggling the spade connectors will help, but use care to not bend the PCA-mounted connections.

   b. Pull straight up with a needle nose pliers to disconnect the one remaining wire. Its other end has already been disconnected from the Power PCA.

Figure 4-28 Keyscan PCA Screws



4. **Unscrew and remove the IrDA break-off PCA. (OPTIONAL)**

   If the Keyscan PCA is being replaced, also remove the IrDA PCA. A replacement IrDA PCA is provided with the replacement Keyscan PCA.

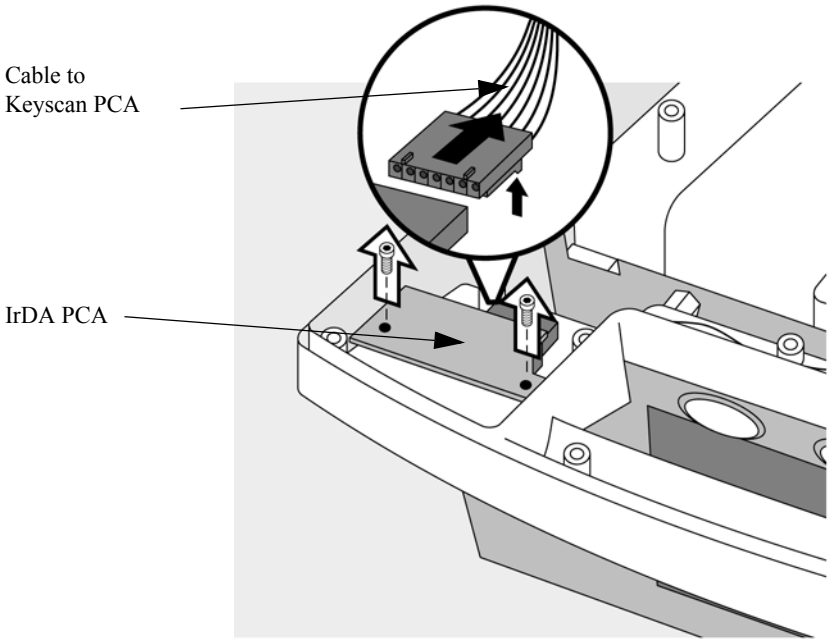
   If the Keyscan PCA is being removed for access to other subassemblies, skip this step.

   a. Remove the two T10 screws that attach the IrDA PCA to the case. See Figure 4-29.

   b. Remove the PCA.

   c. Disconnect the cable from the PCA. Press on the connector latch to release it. Its other end has already been disconnected from the Keyscan PCA.

Figure 4-29 Removing the IrDA PCA



Replacement

1. **Replace the IrDA break-off PCA.**

   If the IrDA PCA was removed, replace it now.

   a. Connect the cable to the IrDA PCA.

   b. Place the IrDA PCA in position inside the top case.

   c. Replace the two screws.

2. **Connect the three individual wires to the Keyscan PCA.**

   a. Connect the longest wire to the spade connector at the lower left edge of the PCA. This wire has spade receptacles on both ends.

   b. Connect the other two wires to the spade connectors at opposite side edges of the PCA (on either end of the power resistors). These wires have ring terminals on their other ends.

3. **Install the Keyscan PCA.**

   a. Align the bottom edge of the PCA with the mating slots in the case. Note that there is also a slot in the PCA which must line up with a rib on the case. See Figure 4-28.

   b. As you lay the PCA against the threaded standoffs, guide the 8-wire bundle through the window in the Keyscan PCA. Make sure the flex circuit is not caught underneath the PCA.

   c. Replace the two T10 screws and tighten.

4. **Reconnect the Keyscan PCA.**

   a. Connect the two paddle wires to the paddles pockets. Connect the display flex circuit.

   b. If you removed the Energy Select Switch, replace it and connect it to the Keyscan PCA. Be sure the connector latches into position securely.

   c. Connect the display 8-wire bundle and display grounding wire (spade connector).

   d. Connect the IrDA break-off PCA.

   e. Route the flex circuits as they originally were, with two above and two below the Keyscan PCA.

   f. Connect the two pacing keypad flex circuits. Have the latching top of the connector up; then slide the flex circuit into place and push the top down to latch it.

   g. Connect the small main keypad flex circuit. Have the latching top of the connector up; then slide the flex circuit into place and push the top down to latch it.

h. Connect the large keypad flex circuit.

NOTE If the Pacing option is not installed, there will be only two flex circuits.

After Repair

After the repair is complete, perform the following steps.

1. **Replace the Shield Plate.**

   See "Shield Plate" on page 4-42.

2. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

3. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

4. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Bezel Assembly

The following sections describe how to remove and replace the Bezel Assembly. The Bezel Assembly comes from the factory with the Main keypad and its rubber overlay pre-installed. The keypad and overlay are not available separately - if the rubber or keypad are damaged, the entire Bezel Assembly must be replaced.

The Bezel Assembly is available in all the supported languages.
See Table 5-6 on page 5-9 for part numbers.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-42.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52.

Removal

1. **Unscrew the** two **threaded standoffs.**

   Using a pliers or wrench, loosen the two standoffs and remove them. See Figure 4-30 on page 4-60.

2. **Remove the plastic shield, if present, and put it aside.**

   You will need to replace this shield later.

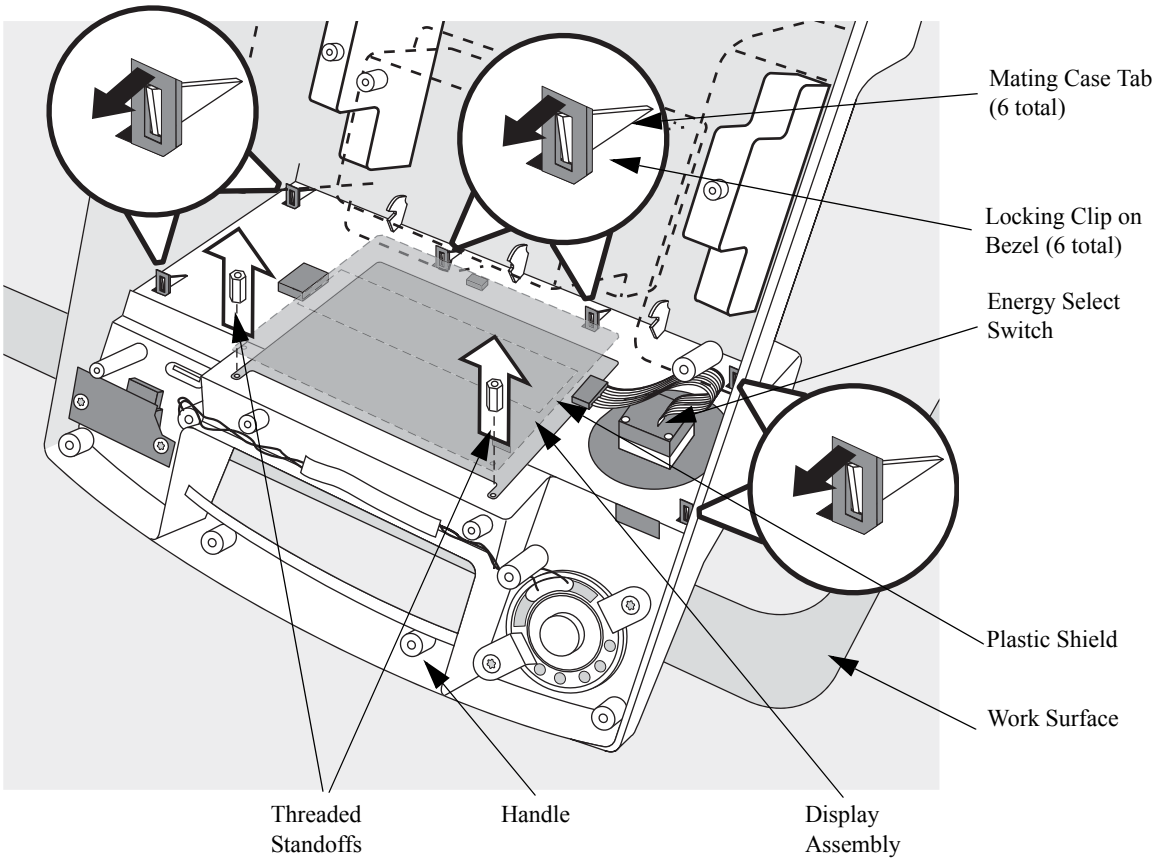
3. **Release the six locking clips.**

   Release each of the six locking clips (inside the case) by pulling up toward you until the clip unlatches from its mating case tab.

   TIP: Unlatch the two clips nearest you first (below the IrDA PCA and below the speaker). Then pivot the Bezel Assembly out from the case and release the 4 clips along the other edge of the Bezel Assembly.

4. **Lift the Bezel Assembly off the front of the case.**

Figure 4-30 Removing the Bezel Assembly



5. **Remove the Energy Select knob and switch. (OPTIONAL)**

   If the Bezel Assembly is being replaced, also remove the Energy Select knob and switch. Additionally, if you are replacing an LCD Display, it may be easier to remove the Energy Select knob and switch. See "Energy Select Switch" on page 4-63.

   If the Bezel Assembly is being removed for access to other subassemblies, skip this step.

6. **Remove the Display Assembly. (OPTIONAL)**

   If the Bezel Assembly is being replaced, also remove the Display Assembly. See "Display Assembly (EL Display)" on page 4-65 or "Display Assembly (LCD Display)" on page 4-68.

   If the Bezel Assembly is being removed for access to other subassemblies, skip this step.

Replacement

1. **Replace the Display Assembly.**

   See "Display Assembly (EL Display)" on page 4-65 or "Display Assembly (LCD Display)" on page 4-68.

NOTE

If you are replacing an LCD Display, replace the Energy Select Knob and Switch ***after*** you replace the Keyscan PCA. This makes it easier to connect the flex circuit from the Display to the Keyscan PCA.

2. **Replace the Energy Select knob and switch.**

   See "Energy Select Switch" on page 4-63.

3. **Snap the Bezel Assembly onto the front of the case.**

   a. Guide the ribbon cables and the flex circuits through their respective openings in the case.

   b. Guide each of the locking clips through its opening in the case.

   c. Press the Bezel Assembly into place. Press firmly to compress the gasket on the case and allow the clips to latch. Be sure all 6 locking clips engage their mating tabs.

4. **Replace the plastic shield, if present.**

   a. **(For devices with an LCD Display).** Guide the 8-wire bundle and flex circuit through the opening in the center of the plastic shield.

   b. **(For devices with an LCD Display).** Let the grounding wire hang off the to the side of the metal shield.

5. **Replace the two threaded standoffs.**

   Press firmly to compress the gasket and allow the standoffs to engage the threads on the Bezel Assembly.

After Repair

After this repair is complete, perform the following steps.

1. **Replace and reconnect the Keyscan PCA.**

   See "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52.

2. **Replace the shield plate.**

   See "Shield Plate" on page 4-42.

3. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

4. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

5. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

6. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Energy Select Switch

The following describes how to remove and replace the Energy Select Switch.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **Remove the Energy Select Knob.**

   Grasp the knob and pull straight out from the Front Bezel.

   TIP: To get a better grip on the knob, try wearing rubber gloves.

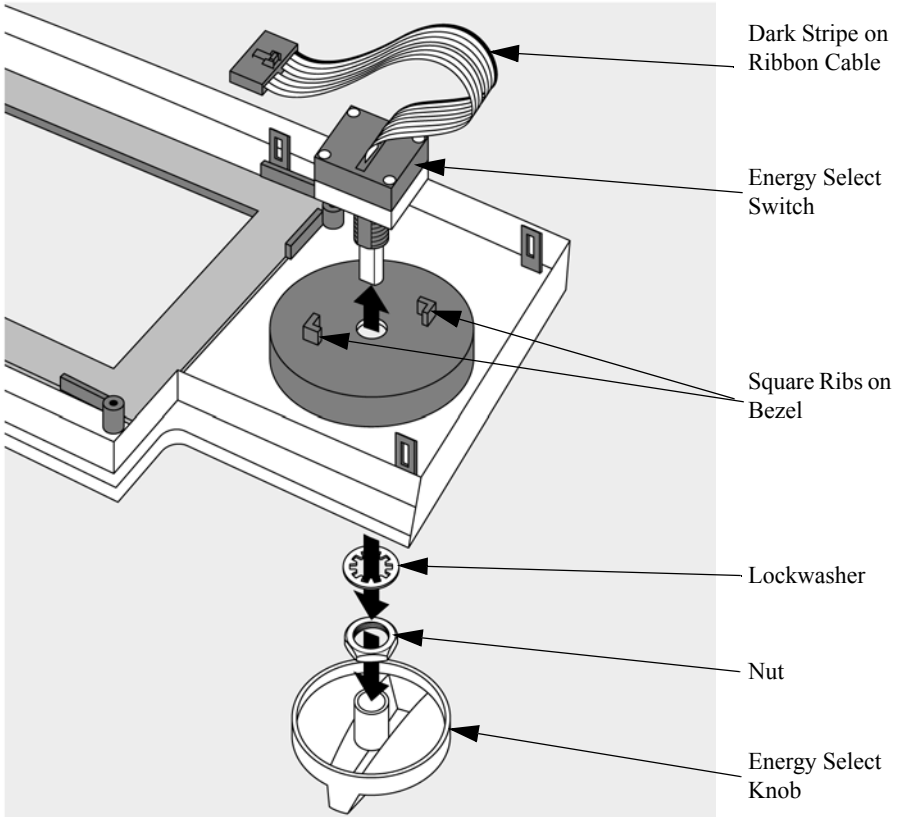
Removal

Disconnect and remove the Energy Select Switch.

a. Unlatch the connector and unplug it from the Keyscan PCA.

b. Using a pliers or wrench, loosen and remove the large nut holding the Energy Select switch into the Bezel. Remove the switch.

Figure 4-31 Energy Select Switch and Knob



Replacement

Replace and reconnect the Energy Select Switch.

a. Insert the Energy Select switch into the hole in the Bezel. Orient it as shown in Figure 4-31.

b. Fit the switch into place between the square ribs on the Bezel. Be sure the switch is fully bottomed against the Bezel.

c. Replace the lockwasher and nut on the shaft. Tighten the nut securely.

d. Plug the connector into the Keyscan PCA. **Be sure it latches.**

After Repair

After this repair is complete, perform the following steps.

1. **Replace the Energy Select Knob.**

   Push the knob onto the shaft. Be sure the knob is pressed fully into place.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

3. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Display Assembly (EL Display)

The following sections describe how to remove and replace the Display Assembly for devices with an EL Display. See "Identifying the Display Type" on page 5-7 for information on what type of Display the device has. The Display Assembly is mounted to the back of the Bezel.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-42.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA (EL Display)" on page 4-44.

6. **Remove the Front Bezel.**

   See "Bezel Assembly" on page 4-59.

Removal

1. **Remove the Display.**

   a. Unscrew the two T10 screws in the corners of the Display. See Figure 4-32 on page 4-66.

   b. Lift the display off the bezel and set it display side down on a static-protected surface.

2. **Disconnect the two ribbon cables from the display.**

   a. Unlatch the larger ribbon connector by pressing out and down on the latches at each end of the connector.

   b. The smaller connector has no latch. Just wiggle it gently from side to side while pulling it out.

Replacement

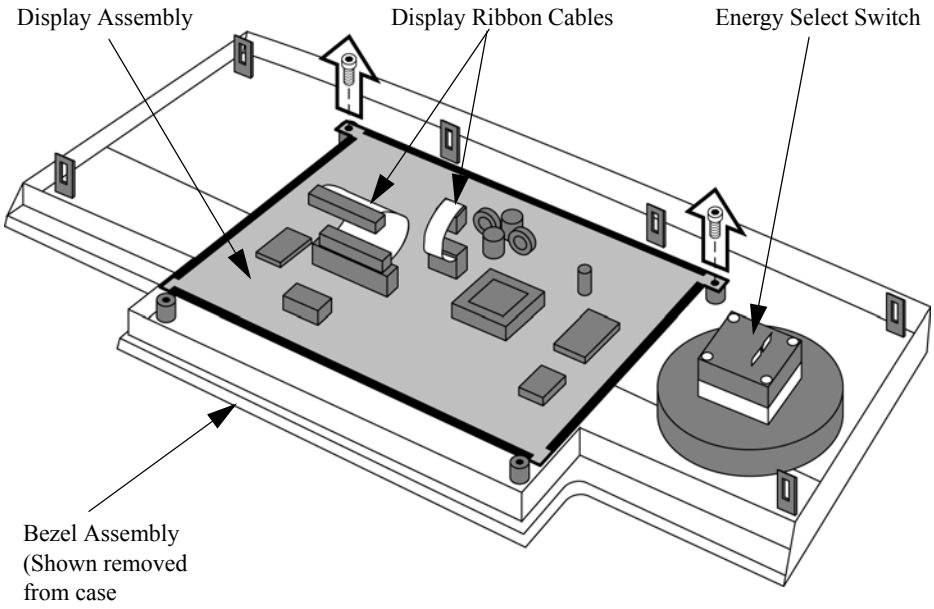
1. **Reconnect the two ribbon cables to the Display.**

   Latch the larger one in position; be sure the smaller one is fully inserted.

2. **Replace the Display on the Bezel.**

   Lay the Display on the Bezel and replace the 2 screws.

Figure 4-32 Removing the Display



After Repair

After repairs are complete, perform the following steps.

1. **Replace the Bezel on the case.**

   See "Bezel Assembly" on page 4-59.

2. **Replace and reconnect the Keyscan PCA.**

   See "Keyscan PCA (EL Display)" on page 4-44.

3. **Replace the shield plate.**

   See "Shield Plate" on page 4-42.

4. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

5. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

6. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

7. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Display Assembly (LCD Display)

The following sections describe how to remove and replace the Display Assembly for devices with an LCD Display. See "Identifying the Display Type" on page 5-7 for information on what type of Display the device has. The Display Assembly is mounted onto a metal shield which then mounted to the back of the Bezel.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-42.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA (LCD Display)" on page 4-52.

6. **Remove the Front Bezel.**

   See "Bezel Assembly" on page 4-59.

Removal

1. **Remove the Display.**

   a. Unscrew the two T10 screws in the corners of the Display. See Figure 4-33 on page 4-69.

   b. Lift the display off the bezel and set it display side down on a static-protected surface.

2. **Remove the metal shield and place to the side.**

   a. Disconnect both 2-wire bundles.

   b. Disconnect the flex circuit from the display and PCA.

   c. Disconnect the 8-wire bundle and place it to the side. You will be replacing them later.

   a. Unscrew the four T10 screws.

   b. Remove the grounding wire and place it to the side. You will be replacing this later.

Replacement

1. **Replace the metal shield.**

   a. Place the metal shield onto the back of the Display. Line the shield up with the large opening over the flex circuit.

   b. Secure the grounding wire to the metal shield with a T10 screw.

   c. Secure the shield to the back of the Display with the remaining 3 T10 screws.

2. **Connect the cables.**

   a. Connect both 2-wire bundles to the inverter board on the metal shield.

   b. Connect the 8 wire bundle to the inverter board on the metal shield.

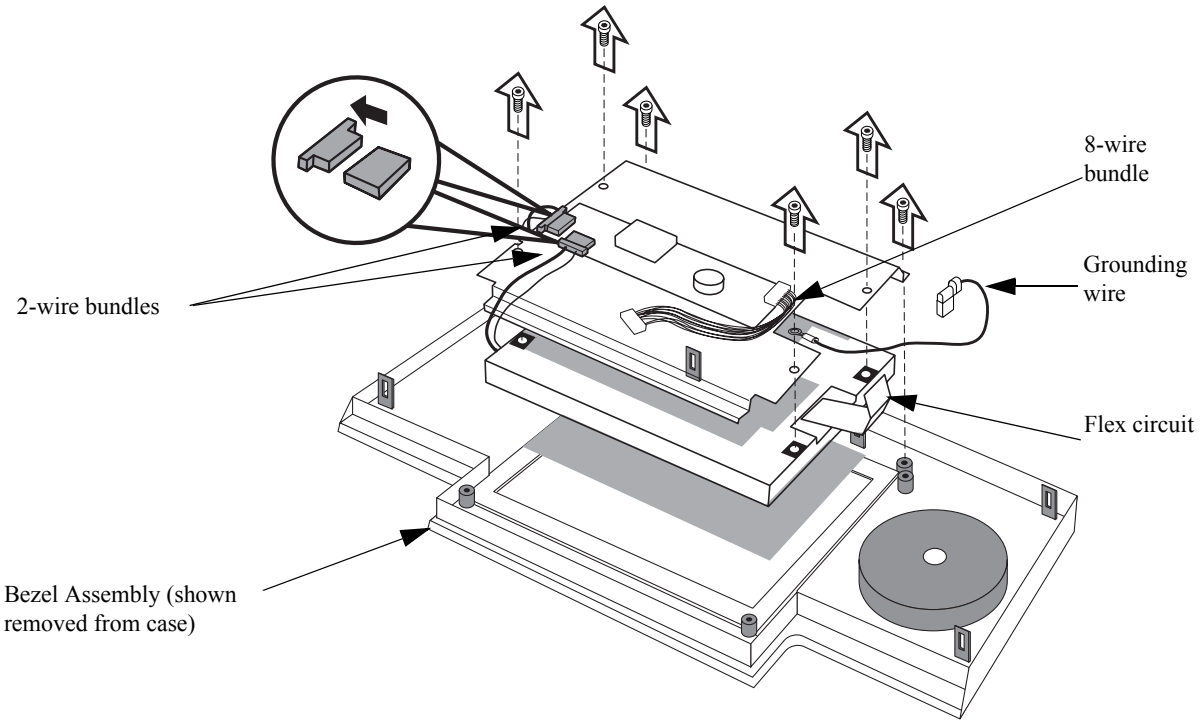
   c. The replacement display may have come with a new flex circuit pre-attached. If it did, connect the free end of the flex circuit to the PCA and discard the old flex circuit. If the display did not come with a new flex circuit pre-attached, proceed with reconnecting the current flex circuit to the display and PCA.

   TIP: Make sure the flex circuit is both centered from side to side in the connector and oriented at 90 degrees to the connector.

3. **Replace the Display on the Bezel.**

   Lay the Display on the Bezel and replace the 2 screws.

Figure 4-33 Removing the Display



After Repair

After repairs are complete, perform the following steps.

1. **Replace the Bezel on the case.**

   See "Bezel Assembly" on page 4-59.

2. **Replace and reconnect the Keyscan PCA.**

   See "Keyscan PCA (LCD Display)" on page 4-52.

3. **Replace the shield plate.**

   See "Shield Plate" on page 4-42.

4. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

5. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

6. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

7. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Hooded Plastic Shield

If your device contains a hooded plastic shield over the Parameter PCA, the removal and replacement procedures are slightly different for the following assemblies:

- Parameter PCA
- SpO2 PCA
- SpO2 Connector
- ECG Connector
- AC Mains Connector

Follow the steps in this section to detach and reattach the hooded plastic shield.

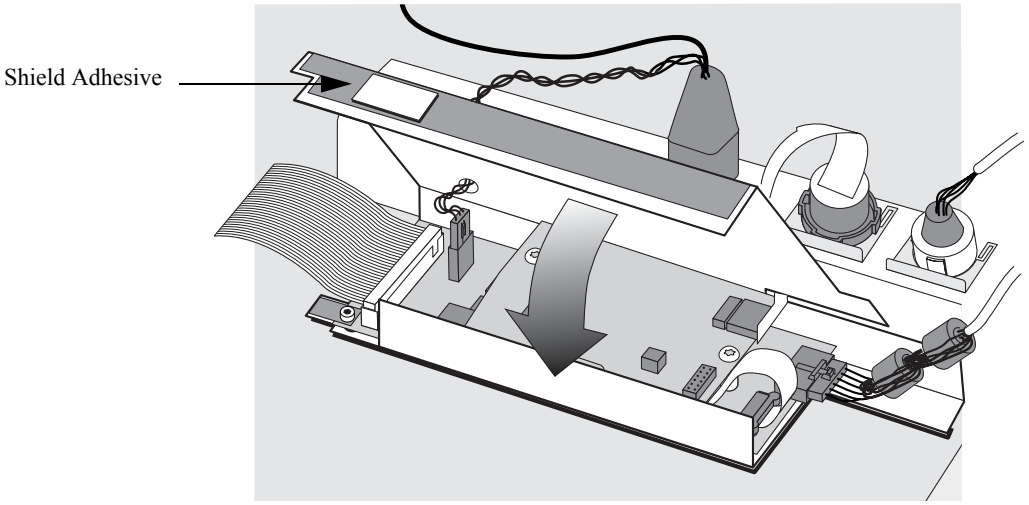
Detaching the hooded plastic shield

1. **Using a small flathead screwdriver, pry the shield adhesive off of the case.**
2. **Lift the hood of the shield to expose the Parameter PCA.**

Reattaching the hooded plastic shield

1. **Clean the Parameter PCA recess of the top case with isopropyl alcohol and allow it to dry.**
2. **Peel one side of the shield adhesive.**
3. **Place the adhesive on the short side of the shield that is half aluminum and half plastic.**
4. **Remove the other side of the shield adhesive.**
5. **Push the flap of the shield down and firmly press it against the printer bucket for several seconds to secure the shield.**

Figure 4-34 Hooded Shield



Parameter PCA

The Parameter PCA is located in the top case, behind the printer bucket. Depending on the serial number and type of Display, your device may have a plastic shield under the Parameter PCA. Additionally, there are two types of plastic shields, one with a hood and one without. See "Identifying the Display Type" on page 5-7 for information on what type of Display the device has. Follow the procedures that match your device.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **If your device has a hooded plastic shield, detach it.**

   See "Detaching the hooded plastic shield" on page 4-71.

4. **Disconnect and remove the SpO_2 PCA.**

   See "SpO2 PCA" on page 4-78.

CAUTION See cautions regarding handling and connection of flex circuits on page 4-1.

Removal

1. **Disconnect the Parameter PCA (four cables).**

   a. Disconnect the large ribbon cable by pulling straight up (connects to the Control PCA).

   b. Disconnect the small 3-pin connector next to the ribbon cable (connects to the ECG Out Connector). Press on the latch to release it.

   c. Disconnect the cable at the opposite end of the PCA (connects to the ECG Connector). Press on the latch to release the connector.

   d. Disconnect the flex circuit (connects to the SpO_2 PCA). Unlatch the brown receptacle on the PCA by pulling on the top of the receptacle, then slide out the flex circuit.

2. **(For devices with no shield.) Remove the Parameter PCA.**

   a. Unscrew the T10 screw located near the large ribbon connector.

   b. Lift the PCA out of the case.

3. **(For devices with an open plastic shield.) Remove the Parameter PCA.**

NOTE You can leave plastic shield in place.

   a. Unscrew the T10 screw located near the large ribbon connector. Be careful not to break the tab.

   b. Lift the PCA out of the case.

4. **(For devices with a hooded plastic shield). Remove the Parameter PCA.**

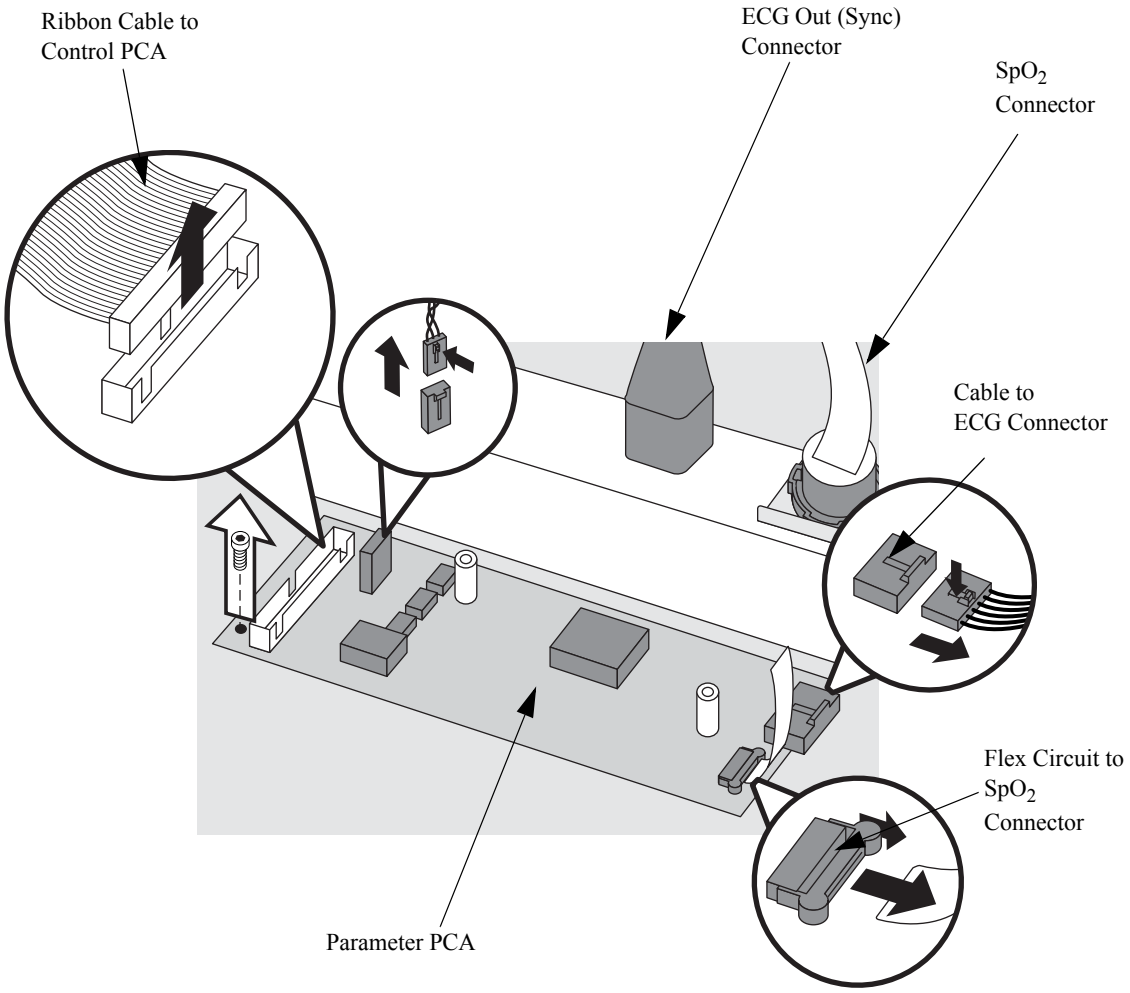
   a. Unscrew the T10 screw located on the tab of the shield, near the large ribbon connector. Be careful not to break the tab.

   b. Lift the PCA out of the case.

   c. Remove the plastic shield, if damaged.

   a. If the shield is not damaged, you can leave it in place. Otherwise, remove the two rubber standoffs and the shield.

Figure 4-35 Removing the Parameter PCA



5. **Remove the Parameter PCA.**

   b. Lift the PCA out of the case.

Replacement

1. **(For devices with no shield or an open plastic shield). Replace the Parameter PCA.**

   a. Connect the SpO_2 flex circuit. Slide the flex circuit into place, then latch the receptacle by pushing in on the top of the receptacle.

   b. Lay the Parameter PCA in position in the top case or on the shield, if present.

NOTE

If your device has a plastic shield, make sure the shield tab is not caught under the Parameter PCA.

   c. Replace the T10 screw near the large ribbon connector.

2. **(For devices with a hooded shield). Replace the plastic shield and rubber standoffs, if necessary.**

   a. Clean the Parameter PCA recess of the top case with isopropyl alcohol and allow it to dry.

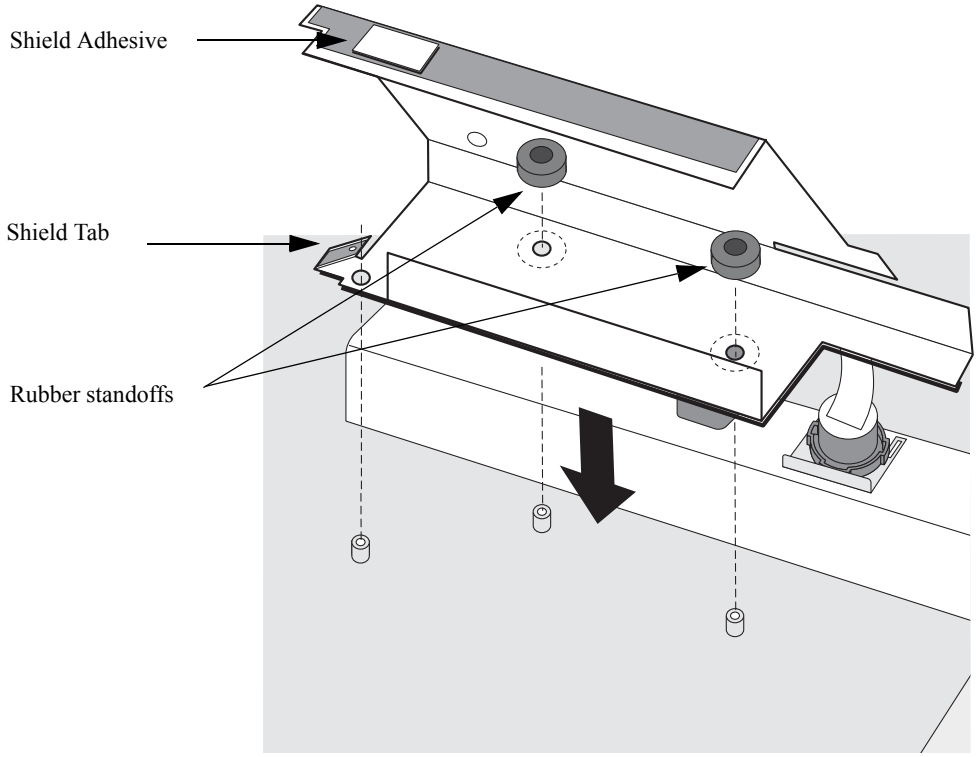
   b. Peel one side of the shield adhesive.

   c. Place the adhesive on the short side of the shield that is half aluminum and half plastic.

   d. Place the shield into the recess with the shield tab up. Make sure the shield lays under the ECG connector.

   e. Place the rubber standoffs over the posts in the case.

Figure 4-36 Replacing the Hooded Plastic Shield



3. **(For devices with a hooded shield). Replace the Parameter PCA.**

   a. Connect the SpO_2 flex circuit. Slide the flex circuit into place, then latch the receptacle by pushing in on the top of the receptacle.

   b. Connect the ECG Connector cable. Be sure the connection latches.

   c. Lay the Parameter PCA in position on top of the shield and standoffs. The PCA fits on top of the shield.

NOTE Make sure the shield tab is not caught under the Parameter PCA.

   d. Secure the shield tab.

4. **Connect the Parameter PCA.**

   a. If you haven't already done so, connect the ECG Connector cable. Be sure the connection latches.

   b. Connect the large ribbon cable (connects to the Control PCA).

   c. Connect the small 3-pin connector next to the ribbon cable. Route through the hole in the hooded plastic shield, if present.

After Repair

After repairs are complete, perform the following steps.

1. **Replace and connect the SpO_2 PCA.**

   See "SpO2 PCA" on page 4-78.

2. **If your device has a hooded plastic shield, secure it.**

   See "Reattaching the hooded plastic shield" on page 4-71.

3. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

4. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

SpO_2 PCA

The SpO_2 PCA (optional) is located in the top case, behind the printer bucket. It is mounted on top of the Parameter PCA. The following sections describe how to remove and replace the SpO_2 PCA.

NOTE If you are replacing the SpO_2 PCA in a device, upgrade the device's software to the current release after the repair. See instructions in the "After Repair" section.

CAUTION See cautions regarding handling and connection of flex circuits on page 4-1.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **If your device has a hooded plastic shield, detach it.**

   See "Detaching the hooded plastic shield" on page 4-71.

Removal

1. **Disconnect the SpO_2 PCA.**

   a. Disconnect the flex circuit from the SpO_2 connector. There is no latch; pull straight out from the PCA connector.

   b. Disconnect the flex circuit from the SpO_2 PCA. Some PCAs have a latching connector and some have a push-in connector. Refer to the steps and figures that match your device.

      Latching connector - Unlatch the brown receptacle on the PCA by pulling on the top of the receptacle, then slide out the flex circuit. See Figure 4-37.

      Push-in connector - There is no latch; pull straight out from the PCA connector. See Figure 4-38.

2. **Remove the SpO_2 PCA.**

   a. Remove the two long T10 screws.

   b. Lift the PCA out of the case.

Replacement

1. **Replace the SpO_2 PCA.**

   Lower the PCA into position on top of the Parameter PCA. The SpO_2 PCA should be oriented so the 2 connectors are on top, and pointing to the right.

2. **Connect the SpO_2 PCA.**

   a. Connect the flex circuit from the Parameter PCA. For SpO_2 PCAs that had a latching connector, you need to install the new flex circuit. Slide the new flex circuit into place, then latch the receptacle on the Parameter PCA by pushing in on top of the receptacle.

   For devices with a push-in connector, you do not need the flex circuit that comes with the replacement kit but can use the current flex circuit.

   b. Push the flex circuit from the SpO_2 connector straight into the PCA connector. There is no latch; push.

3. **Replace the two long T10 screws.**

Figure 4-37 Removing the SpO_2 PCA on Devices with a Latching Connector

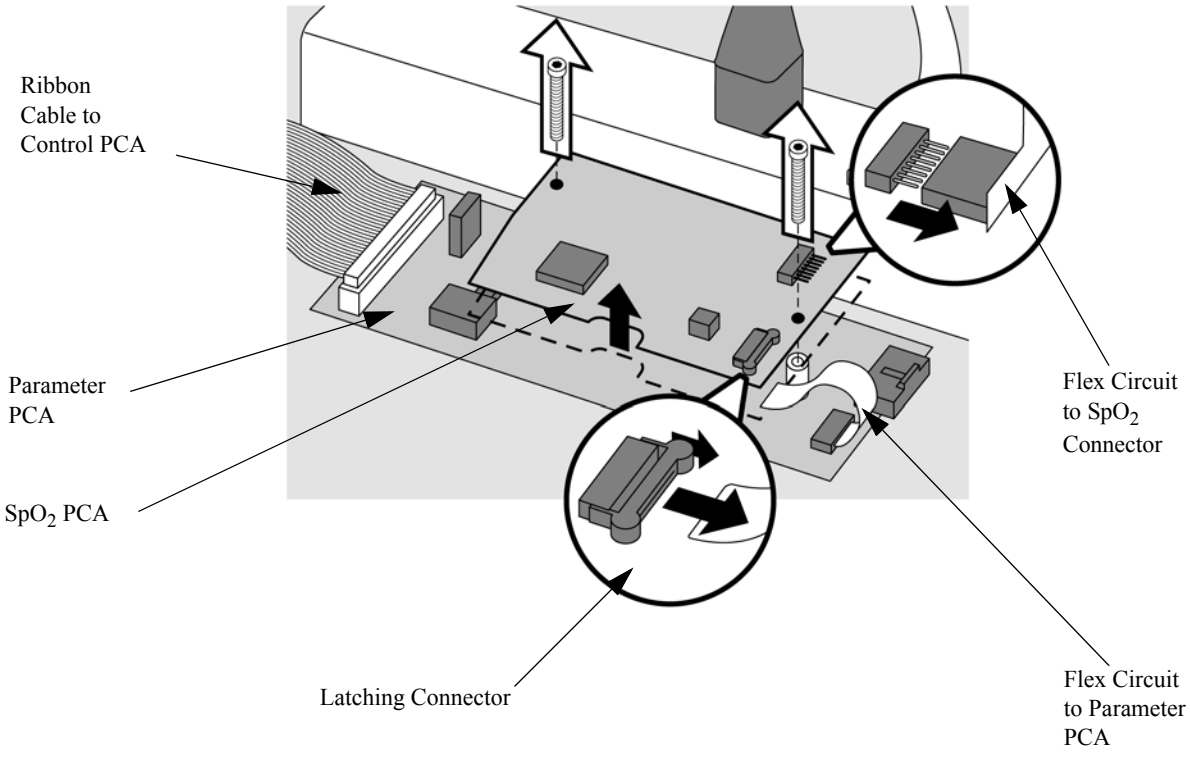
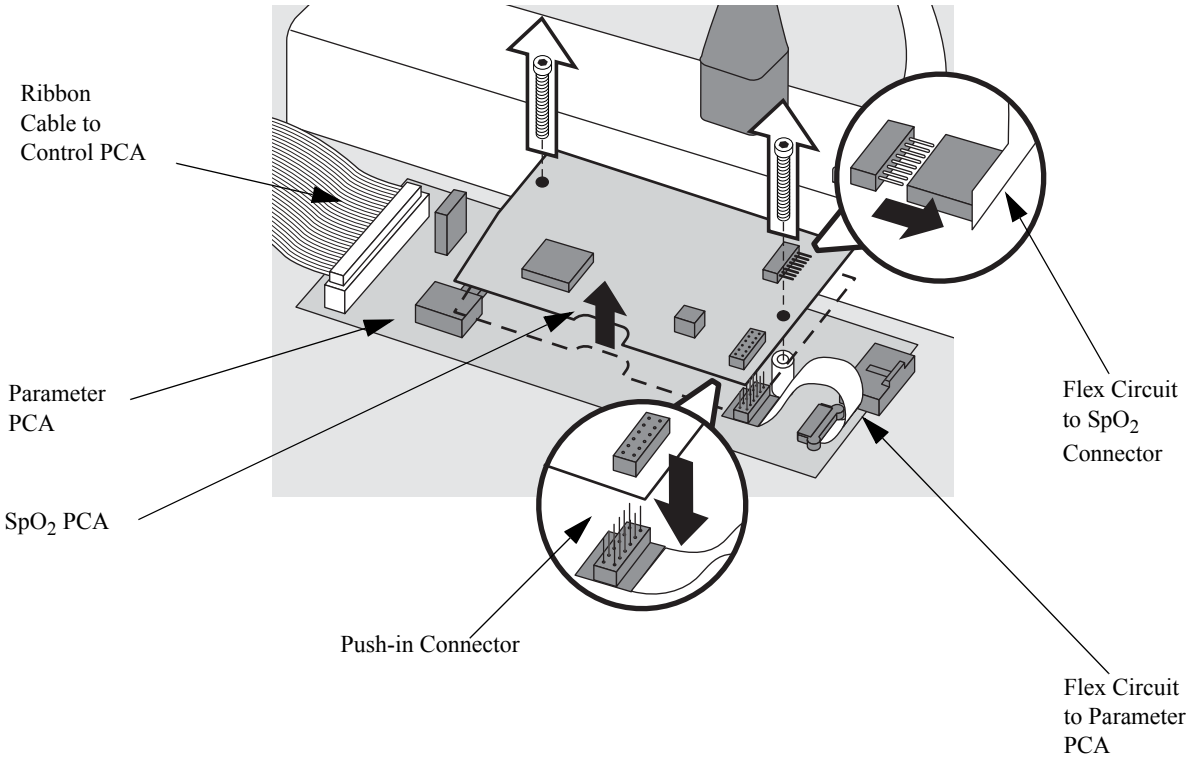


Figure 4-38 Removing the SpO_2 PCA on Devices with a Push-in Connector



After Repair

After repairs are complete, perform the following steps.

1. **If your device has a hooded plastic shield, secure it.**

   See "Reattaching the hooded plastic shield" on page 4-71.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

3. **Install the current software release. If the device already has the current software, you can skip this step.**

   Use the Language Support Tool to update the device's software to the current release. See "The Language Support Tool" on page 2-12.

4. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

ECG Connector

The ECG connector is located at the back of the top case, next to the SpO_2 connector (if present). The ECG Connector kit contains a metal ECG Holder that keeps the cable in place. It is important that you install the ECG Holder according to the directions in this section.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **If your device has a hooded plastic shield, detach it.**

   See "Detaching the hooded plastic shield" on page 4-71.

Removal

1. **Disconnect the ECG Connector.**

   Disconnect the cable from the ECG Connector to the Parameter PCA at the Parameter PCA. Press on the latch to release the connector.

2. **Remove the ECG Holder.**

   The metal ECG Holder fits over the back of the ECG Connector. The holder is in turn captured under the nearby case standoff.

   a. Unscrew the ***gray*** case standoff that holds the ECG Holder in place.

NOTE

The two case standoffs are different colors. They are slightly different lengths and are ***not*** interchangeable.

   b. Remove the ECG Holder.

3. **Unlatch and remove the ECG Connector.**

   a. Release the locking tabs on the metal clip around the ECG connector using a small flat-bladed screwdriver. Pull and remove the metal clip.

   b. Slide the connector, cable, gasket and ferrite out through the hole.

Replacement

1. **Replace the ECG Connector.**

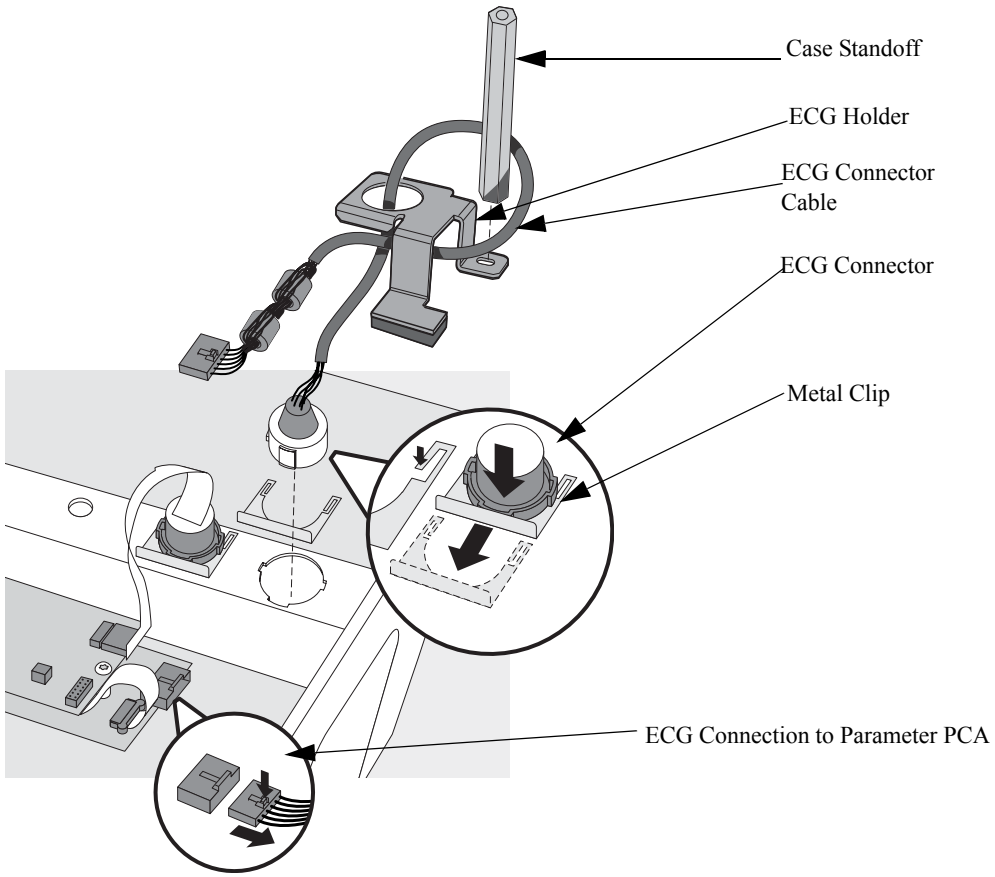
   a. Using the new gasket that came with the connector, install the gasket in place on the connector. Slide the cable through the hole.

   b. Align the connector with the notches in the case and insert it in the hole. Make sure the gasket is in place properly, between the connector and the outside of the case.

   c. Press in firmly on the connector to compress the gasket. Slide the metal clip into place behind the two plastic lugs on the connector, being sure it locks into place. Use the new retainer clip that came with the connector. See Figure 4-39 on page 4-82.

2. **Replace the ECG Holder.**
   a. Use the new ECG Holder that came with the connector. Slide the large hole in the ECG Holder onto the cable and down over the ECG Connector.
   b. Loop the ECG Connector under the leg of the ECG Holder with the black rubber.
   c. As the ECG Holder drops into place, align the small slot over the threaded post in the case, with the bent section down toward the post. Be sure the holder fits over the end of the metal clip.
   d. Loop the cable around the case standoff.
   e. Install the ***gray*** case standoff onto the threaded post; tighten firmly.
3. **Connect the ECG Connector**
   a. Connect the ECG connector cable to the Parameter PCA, being sure the connector latches.

Figure 4-39 Removing the ECG Connector



After Repair

After repairs are complete, perform the following steps.

1. **If your device has a hooded plastic shield, secure it.**

   See "Reattaching the hooded plastic shield" on page 4-71.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

SpO_2 Connector

The SpO_2 Connector (optional) is located at the back of the top case, next to the ECG Connector.

CAUTION See cautions regarding handling and connection of flex circuits on page 4-1.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **If your device has a hooded plastic shield, detach it.**

   See "Detaching the hooded plastic shield" on page 4-71.

Removal

1. **Disconnect the SpO_2 Connector.**

   a. Note the orientation and placement of the flex circuit between the SpO_2 connector and the SpO_2 PCA. Disconnect it at the SpO_2 PCA. There is no latch - just pull it straight out.

   b. Leave the flex circuit from the SpO_2 PCA to the Parameter PCA connected.

2. **Remove the SpO_2 Connector**

   a. Release the locking tabs on the metal clip around the SpO_2 connector using a small flat-bladed screwdriver. Pull and remove the metal clip. See Figure 4-41 on page 4-86.

   b. Slide the connector, gasket, and flex circuit out through the hole in the case.

Replacement

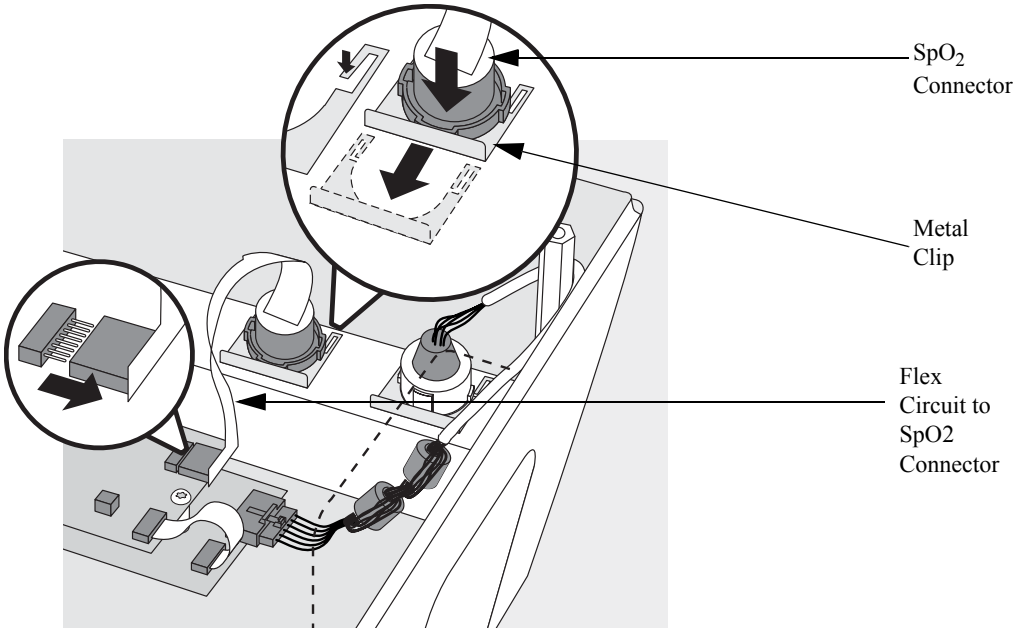
1. **Replace the SpO_2 Connector.**

   a. Install the new gasket in place on the new connector. Slide the connector and flex back through the hole in the case.

   b. Align the connector and gasket with the notches in the case and insert it in the hole. Make sure the gasket is in place properly, between the connector and the outside of the case.

   c. Press in firmly on the connector to compress the gasket. Slide the metal retainer clip into place behind the two plastic lugs on the connector, being sure it locks into place. Use the new retainer clip that came with the connector. See Figure 4-41 on page 4-86.

Figure 4-40 Removing the SpO_2 Connector



2. **Connect the SpO_2 Connector.**
   a. Connect the flex circuit from the SpO_2 connector to the SpO_2 PCA. Line it up carefully, avoiding excessive twisting. There is no latch - just push straight in. See Figure 4-37 on page 4-79.

After Repair

After repairs are complete, perform the following steps.

1. **If your device has a hooded plastic shield, secure it.**

   See "Reattaching the hooded plastic shield" on page 4-71.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

3. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

4. **Test performance.**
   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Speaker

These instructions describe how to remove and replace the speaker assembly.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal

1. **Disconnect the Speaker**

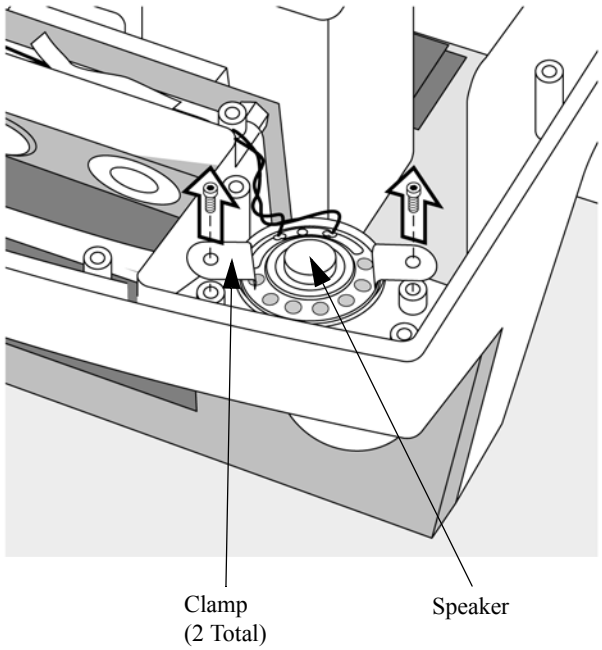
   Disconnect the speaker from the Control PCA. Refer to Figure 4-20 on page 4-39 to identify the speaker connector.

2. **Remove the speaker.**

   a. Remove the two screws and clamps from the speaker. See Figure 4-41.

   b. Peel up the tape holding the wires in place. Lift the speaker and its wires out of the case.

Figure 4-41 Removing the Speaker



Replacement

1. **Replace the Speaker.**

   a. Place the new speaker into position in the case.

   b. Install both clamps and both screws. See Figure 4-41 on page 4-86.

   c. Lay the wires in the same position in the case as were the original wires and secure with the original tape (or with other plastic electrical tape).

2. **Connect the Speaker.**

   Connect the speaker to the Control PCA. Refer to Figure 4-20 on page 4-39.

After Repair

After repairs are complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on
   page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

AC Mains Connector

The AC Mains Connector is located at the rear of the top case, on the back wall. It is part of one assembly with the ECG Out (Sync) connector.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **If your device has a hooded plastic shield, detach it.**

   See "Detaching the hooded plastic shield" on page 4-71.

Removal

1. **Disconnect and remove the ECG Out (Sync) Connector.**

   a. Disconnect the 3-pin connector from the Parameter PCA. Press on its latch to release.

   b. Turn the top case over rightside up.

   c. Using a pliers or wrench, loosen the large nut on the ECG Out Connector. Remove the nut and the washer.

   d. Turn the top case upside down.

   e. Remove the ECG Out Connector from its hole. It will still be attached to the AC Mains Connector.

2. **Remove the AC Mains Connector.**

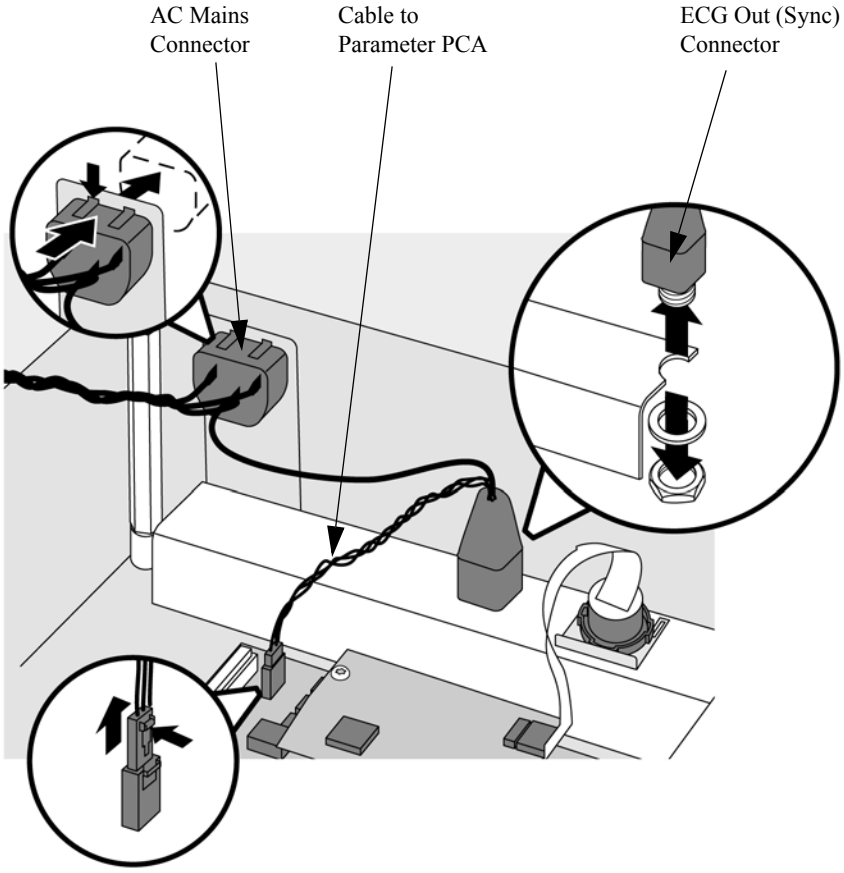
   a. The AC Mains Connector should already be disconnected from the Power Supply in the bottom case. If it is not, disconnect it now. See "Opening the Case" on page 4-26.

   b. Using a flat bladed screwdriver, press in on the locking tabs on the top of the AC Mains Connector to release the top edge from the case. The tabs will be difficult to depress.

   c. Reach under the AC Mains Connector with your fingers and press in on the locking tab to release the connector from the case.

   d. Remove the AC Mains Connector, along with the ECG Out Connector and the attached cables.

Figure 4-42 Removing the AC Mains and ECG Out Connectors



Replacement

1. **Replace the AC Mains Connector.**

   a. Feed the ECG Out Connector and the attached cables through the hole in the case first, then insert the AC Mains connector into the hole last.

   b. Press the AC Mains connector into place. Be sure all the latches snap into place. It should be oriented as shown in Figure 4-42, with the ground lug (green wire) toward the top of the case.

2. **Replace the ECG Out (Sync) Connector.**

   a. Replace the ECG Out Connector in its hole in the case. Align one of the flat sides against the ribs in the case.

NOTE

One corner of the ECG Out connector is rounded. Keep that away from the ribs, so the ribs can prevent the connector from rotating in either direction.

   b. Replace the washer and nut on the connector, and tighten the nut.

   c. Connect the 3-pin connector to the Parameter PCA. Route through the hole in the hooded plastic shield, if present. Be sure it latches in place.

After Repair

After repairs are complete, perform the following steps.

1. **If your device has a hooded plastic shield, secure it.**

   See "Reattaching the hooded plastic shield" on page 4-71.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

3. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

ECG Out (Sync) Connector

The ECG Out (Sync) Connector is located at the rear of the top case, next to the SpO_2 connector. It is part of one assembly with the AC Mains connector.

For Removal and Replacement procedures, see "AC Mains Connector" on page 4-88.

Pacer Keypad

The following sections describe how to remove and replace the Pacer Keypad.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-38.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-42.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52.

6. **Remove the Bezel Assembly.**

   See "Bezel Assembly" on page 4-59.

Removal

1. **Flip the case over and remove the Pacer Keypad.**

   a. Flip the top case over rightside up. Place it on the bottom case for support.

   b. Using needle nose pliers, grasp one corner of the rubber overlay and pull up. The overlay will peel up; the membrane switches underneath may or may not come up with the overlay.

   c. If the membrane switches are still in place, use a sharp tool such as a utility knife to pick up one corner, then peel them up with needle nose pliers. The membrane switches may peel apart into several layers - be sure to remove all layers.

   d. Slide the two flex circuit tails out of the slot in the case.

Figure 4-43 Peeling up the Rubber Overlay

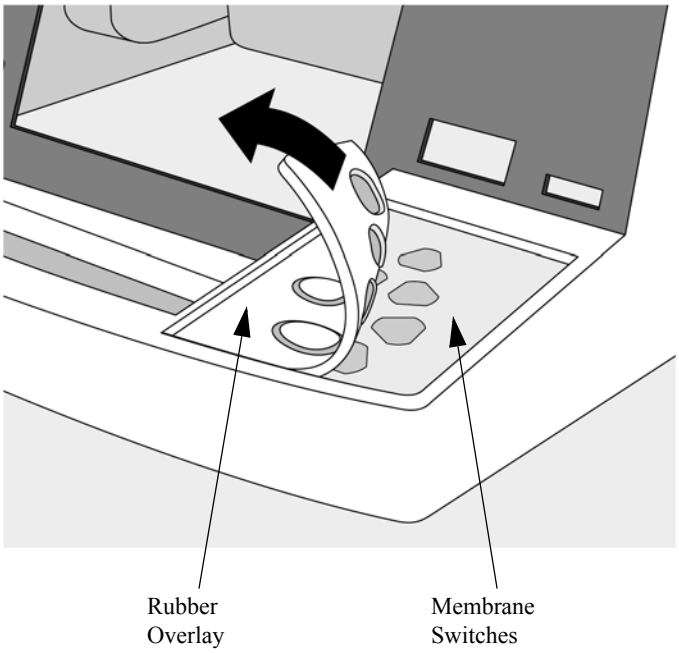
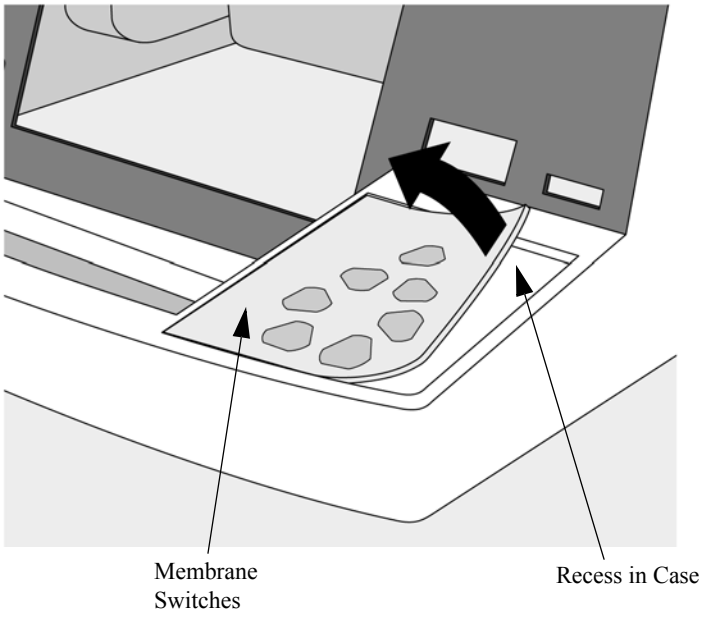


Figure 4-44 Peeling up the Membrane Switches



Replacement

1. **Prepare the case.**

   a. Clean off all adhesive residue from the case by rubbing the dry surface with your finger and "rolling up" any adhesive.

   TIP: Lightly scoring the adhesive with a rounded tool will aid removal. Solvents are ineffective, as is scraping with a sharp tool.

NOTE

The adhesive used is difficult to remove. Take your time and do a thorough job to ensure a correct seal with the new switches and overlay.

   b. Clean surfaces thoroughly with isopropyl alcohol (an alcohol wipe is fine). Allow to dry completely.

2. **Replace the membrane switches.**

   a. Feed the two flex circuits down through the slot in the case as shown in Figure 4-45 on page 4-95.

   b. Peel the backing material off the new switches. Handle very carefully and touch the adhesive as little as possible.

   c. Starting with the top edge, align the switches very carefully in their recess in the case and roll them down slowly into place. Be careful not to kink the flex circuit tails as you slide them into their slot under the switches.

   d. Press firmly all over, especially the edges, to adhere the new switches into place and seal the case opening.

3. **Replace the Overlay.**

   a. Clean the surfaces of the case and membrane switches (***not*** the rubber overlay) thoroughly with isopropyl alcohol (an alcohol wipe is fine). Allow to dry completely.

   b. Peel the backing material off the Rubber Overlay. Handle carefully and touch the adhesive as little as possible.

   c. Starting with the top edge, align the Overlay exactly and roll it down slowly into place. See Figure 4-46 on page 4-95.

   d. Press firmly all over, especially the edges, to adhere the new Overlay into place.

Figure 4-45 Installing the Membrane Switches

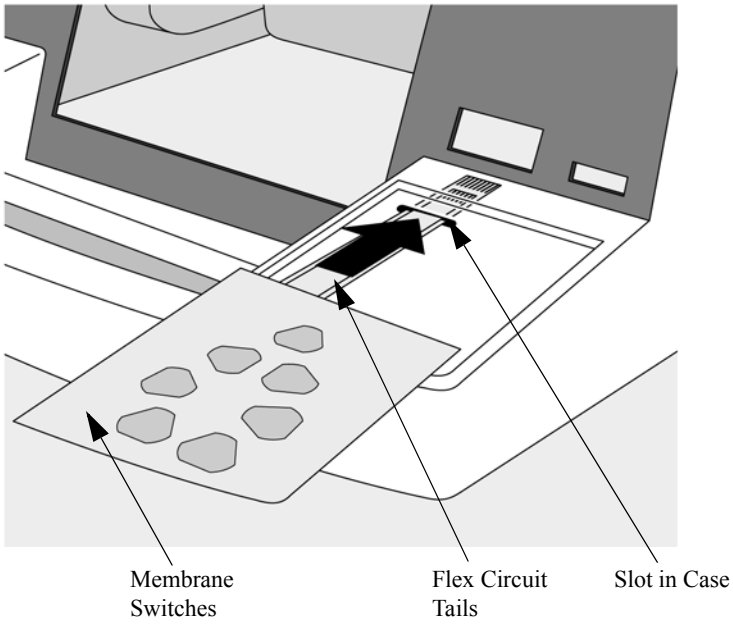
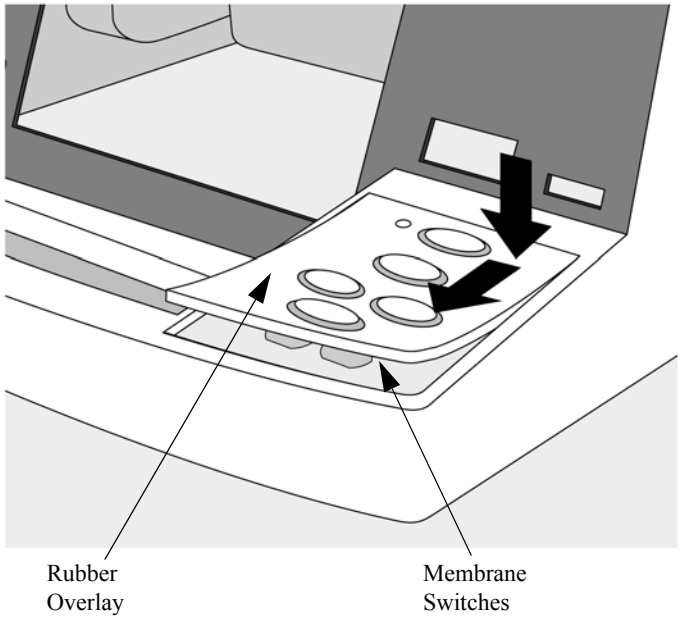


Figure 4-46 Replacing the Rubber Overlay



After Repair

After repairs are complete, perform the following steps.

1. **Replace the Bezel.**

   See "Bezel Assembly" on page 4-59.

2. **Replace the Keyscan PCA.**

   See "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52.

3. **Replace the Shield Plate.**

   See "Shield Plate" on page 4-42.

4. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-38.

5. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

6. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

7. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Replacement Top Case

The following sections describe how to remove and replace the Top Case Assembly.

Description

The top case assembly consists of the following components, all preassembled into the case at the factory.

- Bezel gasket.
- IRDA lens.
- Printer ribbon cable.
- Case standoffs (tall hex posts). One will be installed, one will be supplied loose.
- Hole plug and gasket (for SpO_2 hole).
- Speaker label.
- Branding labels.

NOTE

The two case standoffs are different colors. They are slightly different lengths and are ***not*** interchangeable.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal and replacement

The Top Case is probably the most difficult and time consuming repair that can be done on the M4735A:

- Several existing parts need to be moved from the old case to the new.
- Several new parts must be installed:
  - some come with the top case.
  - some must be ordered separately.

Parts to be moved from old top case to new

The following subassemblies must be removed from the old top case and installed into the new one. Follow the Removal and Replacement instructions in this chapter for each subassembly. Remove them in the order shown, and replace them in reverse order.

1. Printer (see "Printer Assembly" on page 4-7).
2. Paddle Holders (see "Paddle Holders" on page 4-20).
3. Control PCA (see "Control PCA" on page 4-38).
4. Shield Plate (see "Shield Plate" on page 4-42).
5. IrDA break-off PCA (see "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52).
6. Keyscan PCA (see "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52).
7. Bezel Assembly (with Energy Select switch and Display attached) (see "Bezel Assembly" on page 4-59).
8. AC Mains Connector and ECG Out Connector see "AC Mains Connector" on page 4-88).
9. SpO_2 connector and flex circuit (if present) (see "SpO2 Connector" on page 4-84).
10. ECG connector with cable and ferrite (see "ECG Connector" on page 4-81).
11. SpO_2 PCA (if present) and flex circuit (see "SpO2 PCA" on page 4-78). The flex circuit will be reused.
12. Parameter PCA (see "Parameter PCA" on page 4-72).
13. Speaker and mounting hardware (see "Speaker" on page 4-86).

New parts to be installed - provided with top case

The Replacement Top Case Assembly comes with the following new components, which must be installed in the field. ***Do not reuse the old gaskets or retaining clips.***:

- ECG/SpO_2 connector gaskets (not available separately) (see "ECG Connector" on page 4-81 and "SpO2 Connector" on page 4-84).
- ECG/SpO_2 connector retaining clips (M2475-07101) (see "ECG Connector" on page 4-81 and "SpO2 Connector" on page 4-84).
- Short hex standoffs (see "Keyscan PCA (EL Display)" on page 4-44 or "Keyscan PCA (LCD Display)" on page 4-52).
- ECG Holder (see "ECG Connector" on page 4-81).
- Case standoff (see "ECG Connector" on page 4-81).

NOTE

The two case standoffs are different colors. They are slightly different lengths and are ***not*** interchangeable.

New parts to be installed - must be ordered separately

In addition, the following parts cannot be reused from the old case, and must be ordered separately and installed into the new top case:

- Pacer Keypad (if Pacing option ***is*** installed) (see "Pacer Keypad" on page 4-92).

  This is available in all the supported languages.
  See Table 5-7 on page 5-10 to select the correct language.
- Blank Pacer cover (if Pacing option is ***not*** installed)
- Instruction Label Set

  These are available in 2 versions (pacing, no pacing) and in all the supported languages. See Table 5-11 on page 5-13 and Table 5-12 on page 5-14 to select the correct version and language.
- Case Label Set

  These are available in 2 versions (SpO_2, no SpO_2), and in all the supported languages. See Table 5-13 on page 5-15 and Table 5-14 on page 5-16 to select the correct language.

After Repair

After repairs are complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Internal Assemblies – Bottom Case

The sections that follow describe removing and replacing assemblies that reside in the Bottom Case. These assemblies include:

Battery PCA

The Battery PCA is mounted in the Battery compartment, under the Battery Cover. It has a cable assembly that enters the case through a rubber gasket. Once inside the case, the cable assembly connects to the Power PCA and to the Power Supply.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal

1. **Unplug 3 connectors from the Battery PCA.** See Figure 4-47 on page 4-103.

   a. Unplug the 4-pin connector to the Power PCA (the battery connector).

   b. Unplug the 2-pin connector to Power PCA.

   c. Unplug the 2-pin connector to the Power Supply.

2. **Pull the Battery PCA up.** See Figure 4-48 on page 4-103.

   a. Stand the bottom case up on its edge.

   b. Pull the Battery PCA straight up out of its slot in the bottom case.

3. **Pull out the wires and gasket.**

   a. Remove the gasket from its hole in the case.

   TIP: Depress the tabs on the gasket (inside the case) with a small straight-bladed screwdriver. Then pull from the outside of the case and push from the inside to work the gasket free.

   b. Guide the wires and their connectors out of the hole.

Figure 4-47 Battery PCA connections

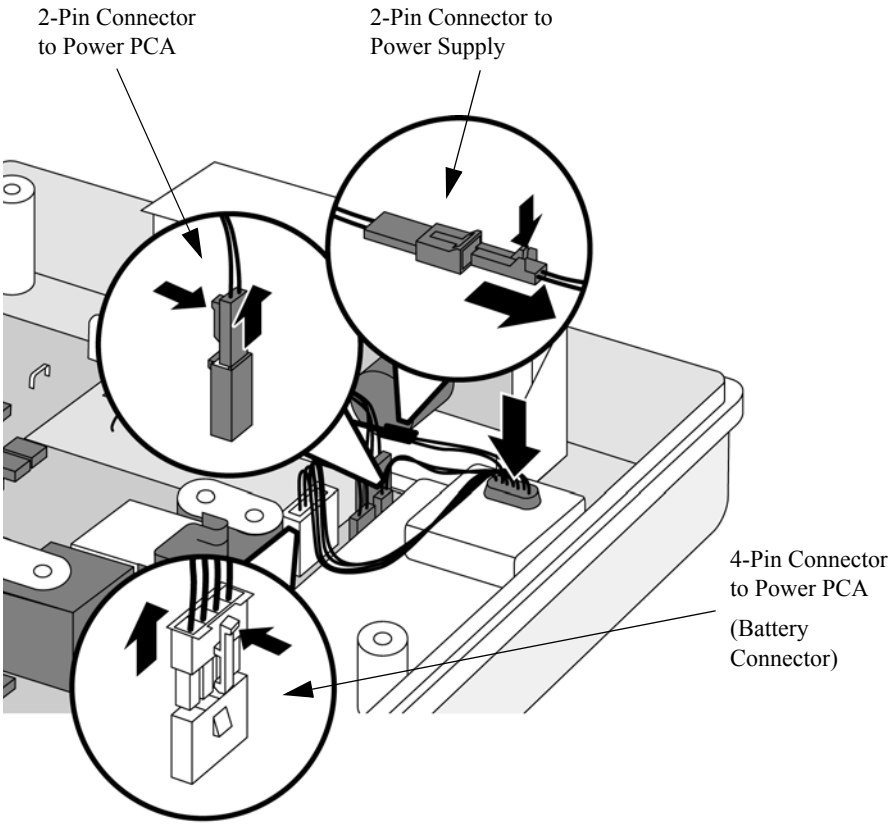
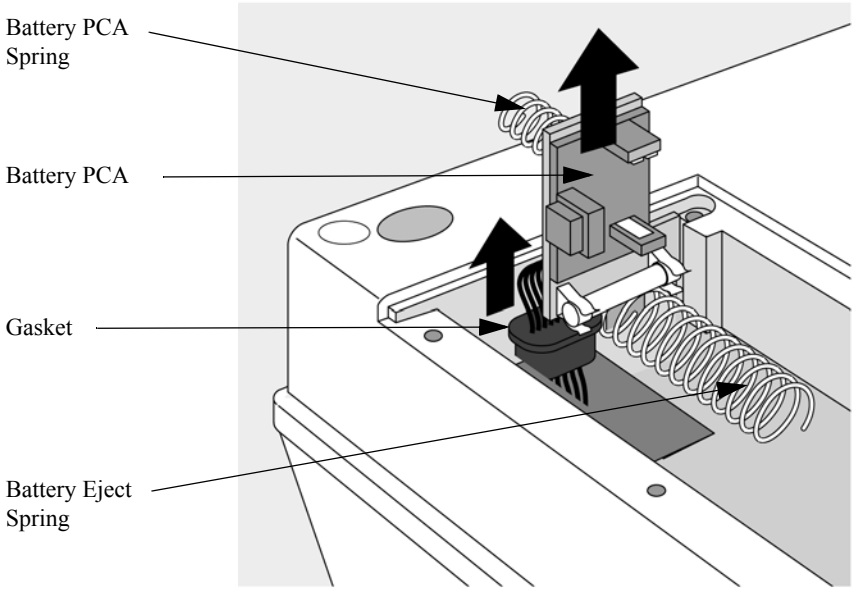


Figure 4-48 Removing the Battery PCA



Replacement

1. **Insert the wires and gasket into the case.**

   a. Start with the two halves of the case mated together. Turn the unit over so the bottom faces up.

   a. Guide the wires and connectors from the new PCA into the hole in the bottom case.

   b. Install the new gasket into the hole.

   TIP: The gasket is fully seated when its tabs protrude out evenly around the hole on the inside of the case.

2. **Replace the Battery PCA into position.**

   a. Install the Battery Plate Spring onto the standoff on the Battery PCA.

   b. Install the Battery PCA into its slot in the case.

3. **Flip the case over and plug in the three connectors.**

   a. Turn the case over so the top faces up

   b. Open the case.

   c. Plug the 4-pin connector onto the Power PCA (the battery connector).

   d. Plug the 2-pin connector onto the Power PCA.

   e. Plug the 2-pin connector into the Power Supply.

After Repair

After this repair is complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit, as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Defibrillator Capacitor

WARNING

Always discharge the defibrillator capacitor before performing any service operations on this unit. See "Separate the Case" on page 4-28.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal

1. **Lift the capacitor out of the way.**

   Lift up the defibrillator capacitor and its foam base. Lift straight up, then turn and rest them on the Power PCA. See Figure 4-49 on page 4-107.

2. **Disconnect the capacitor.**

   a. Before disconnecting the capacitor, note the polarity and routing of its two wires: the red wire to the spade connector next to the red inductor, and the white wire to the spade up in the corner of the Power PCA.

   b. Unplug the defibrillator capacitor from the Power PCA by pulling straight up on its spade connectors with needle nose pliers. Take care to not stress the wires.

3. **Remove the capacitor.**

   a. Slide the wires out through the hole in the foam base.

   b. Using a clip lead, short the capacitor's terminals together to prevent charge accumulation and lay the defibrillator capacitor aside.

Replacement

1. **Replace the capacitor.**

   a. The new capacitor will come with a shorting bar connecting the two terminals. Disconnect the shorting bar.

   b. Slide the wires through the large hole in the foam base.

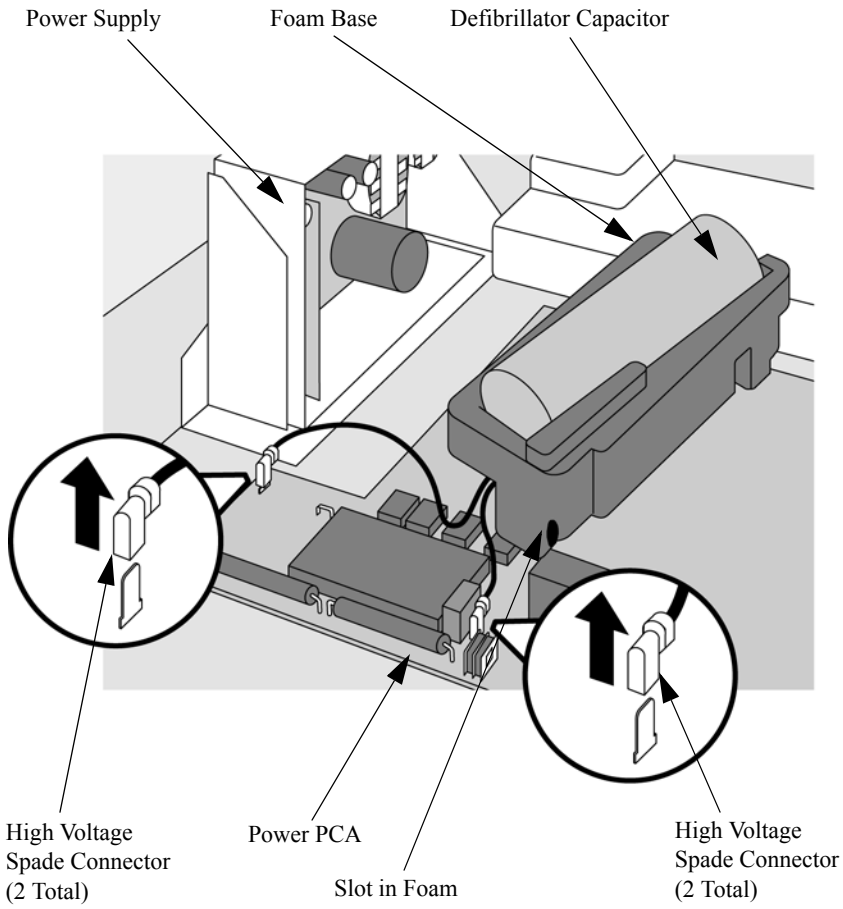
2. **Connect the capacitor.**
   Plug the terminals onto the spade connectors on the Power PCA. Orient the wires so they point toward the center of the Power PCA, as shown in Figure 4-49.

NOTE

The correct polarity is with the red wire near the red inductor and the white wire near the back corner of the Power PCA.

3. **Restore the capacitor to its final position.**
   a. Pivot the capacitor around to the left.
   b. Guide the white wire through the slot in the foam base.
   c. Lower the foam base onto the Power PCA.

Figure 4-49 Disconnecting the Capacitor



After Repair

After this repair is complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Power PCA

The Power PCA is located in the bottom case.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

3. **Disconnect and remove the defibrillator capacitor.**

   See "Defibrillator Capacitor" on page 4-106.

Removal

1. **Disconnect the Patient Connector from the Power PCA.**

   a. Disconnect the 9-pin connector; press on the latch to release. See Figure 4-50 on page 4-109.

   b. Disconnect the two High Voltage spade connectors by pulling up with a needle nose pliers.

2. **Disconnect the Battery PCA from the Power PCA.**

   a. Disconnect the large white 4-pin connector; press on the latch to release. This connector carries the four battery wires (two red, two black).

   b. Disconnect the small 2-pin connector; press on the latch to release.

3. **Disconnect the Power Supply.**

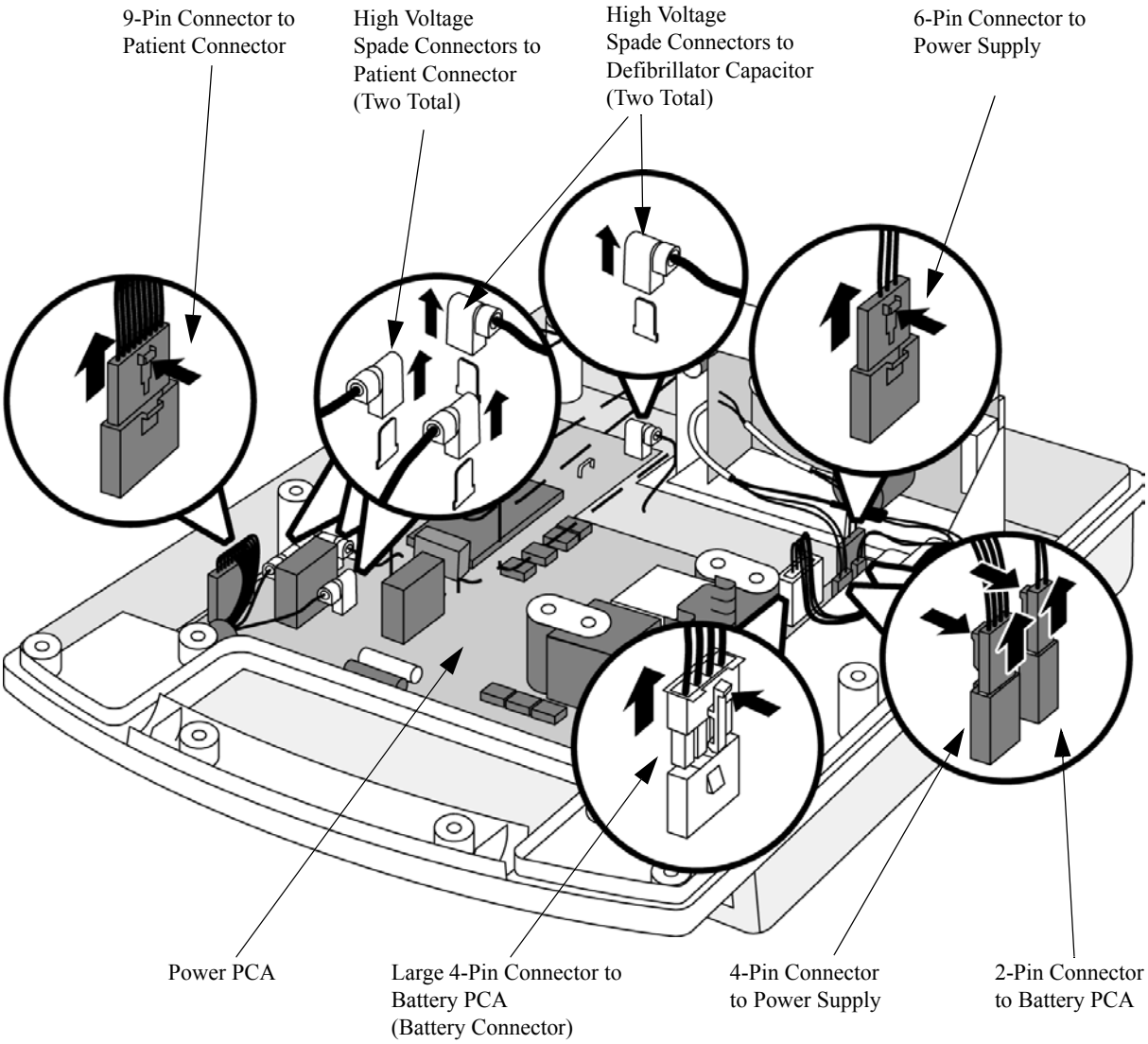
   a. Disconnect the 6-pin connector from the Power PCA; press on the latch to release. Note it only carries three wires.

   b. Disconnect the 4-pin connector from the Power PCA; press on the latch to release.

4. **Disconnect the Control PCA ribbon cable.**

   Disconnect the large ribbon cable from the Control PCA. Its other end should already be disconnected from the Control PCA.

Figure 4-50 Disconnecting the Power PCA



5. **Remove the Power PCA.**

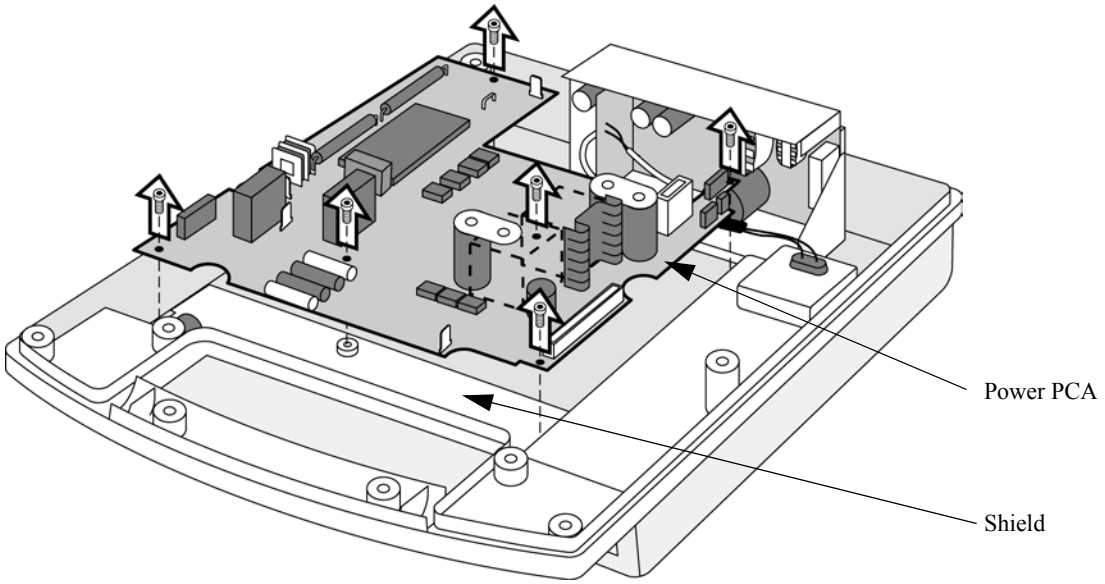
   a. Remove the 6-T10 size screws from the Power PCA.

   b. Pull the Power PCA up and guide it around the Patient Connector and the case post.

   TIP: Lift the back edge of the PCA (nearest the Power Supply) first. Then guide the PCA out to the right to clear the Patient Connector and the case post, and lift the PCA clear of the case.

WARNING **Leave the shield in place in the bottom case, under the Power PCA. Be careful not to cut or puncture the shield.**

Figure 4-51 Removing he Power PCA



Replacement

1. **Replace the Power PCA.**

   a. Ensure the shield is still in its proper position in the bottom case.

   a. Guide the Power PCA into position under the Patient Connector.

   b. Replace the six T10 screws and tighten. See Figure 4-50 on page 4-109.

2. **Connect the Control PCA ribbon cable.**

   Connect the large ribbon cable. Its other end will still be disconnected from the Control PCA.

3. **Connect the Power Supply.**

   a. Connect the 2-pin in-line connector to the Battery PCA; be sure it latches.

   b. Connect the 6-pin connector to the Power PCA; be sure it latches.

   c. Connect the 4-pin connector to the Power PCA; be sure it latches.

4. **Connect the Battery PCA to the Power PCA.**

   a. Connect the 4-pin connector; be sure it latches.

   b. Connect the small 2-pin connector; be sure it latches.

5. **Connect the Patient Connector to the Power PCA.**

   a. Connect the 9-pin connector; be sure it latches.

   b. Connect the two High Voltage spade connectors by pushing straight down with a needle nose pliers.

NOTE The two spade connectors are different sizes to ensure correct connection.

After Repair

After this repair is complete, perform the following steps.

1. **Connect and replace the defibrillator capacitor.**

   See "Defibrillator Capacitor" on page 4-106.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

3. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit as needed. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Power Supply

The following sections describe how to remove and replace the Power Supply. The Power Supply comes with a plastic insulator that you place inside of the Power Supply holder.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal

1. **Remove the screws.**

   a. Orient the M4735A so the end of the bottom case is hanging off the work surface. See Figure 4-54.

   b. Remove the two T15 screws that secure the Power Supply.

   TIP: Another way to remove the screws is to mate the case halves together, flip the case upside down, then remove the screws. Then flip the case rightside up and unmate the case halves.

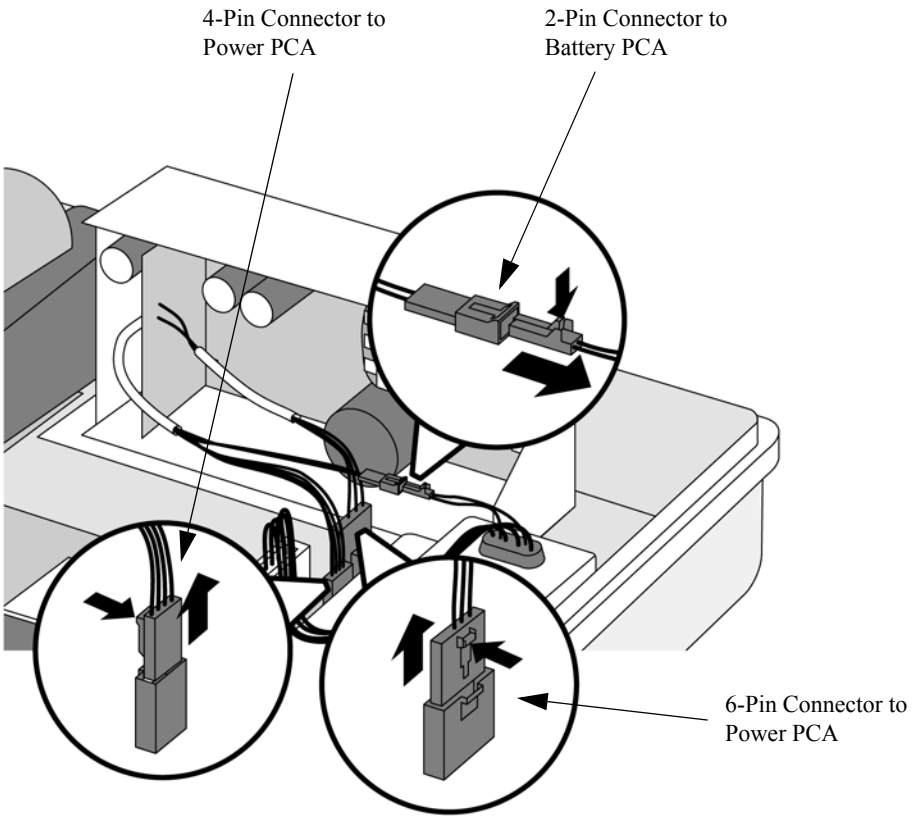
2. **Disconnect the Power Supply.**

   a. Disconnect the 2-pin in-line connector from the Battery PCA; press on the latch to release.

   b. Disconnect the 6-pin connector from the Power PCA; press on the latch to release.

   c. Disconnect the 4-pin connector from the Power PCA; press on the latch to release.

Figure 4-52 Power Supply Connections



3. **Lift the Defibrillator Capacitor out of the way.**

   Lift up the Defibrillator Capacitor together with its foam base. Lift straight up, then turn the capacitor to the right and rest it on the Power PCA. See Figure 4-49 on page 4-107.

4. **Remove the Power Supply.**

   Tilt the top of the Power Supply in toward the Power PCA. Guide the Power Supply out from under the end of the Power PCA, then lift it out of the case.

5. **Remove the Power Supply insulator, if present.**

Figure 4-53 Removing the Power Supply Insulator

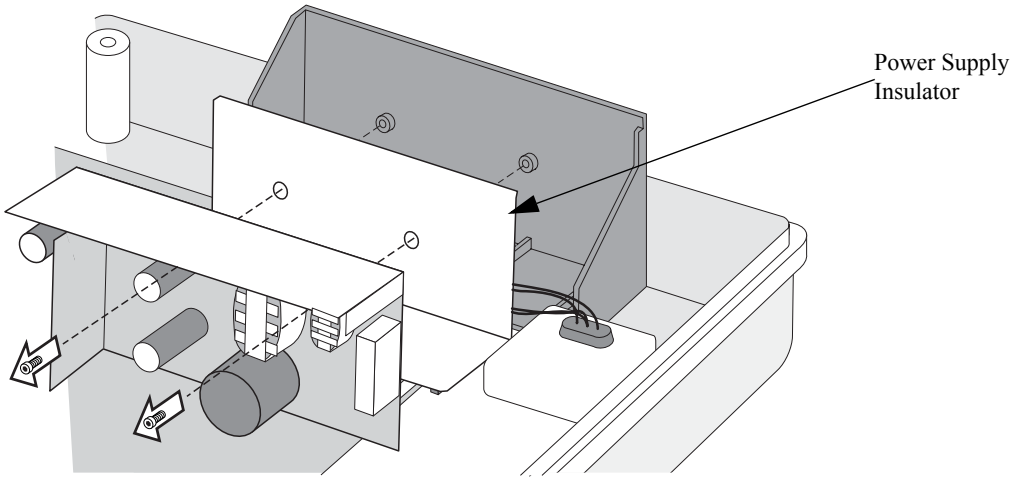
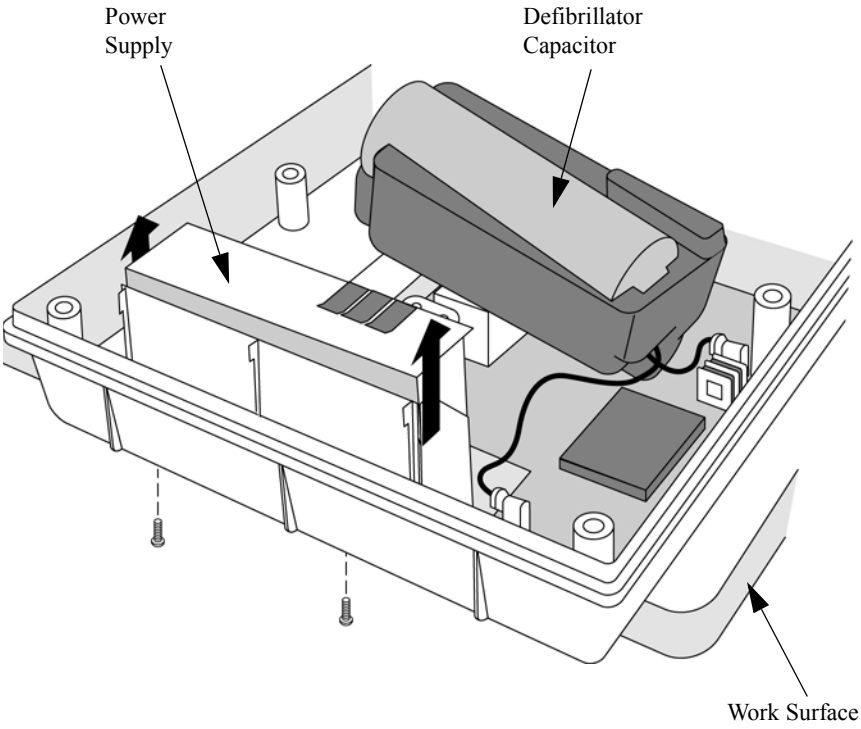


Figure 4-54 Removing the Power Supply



Replacement

1. **Replace the Power Supply.**
   a. Place the Power Supply insulator inside the Power Module.
   b. Guide the bottom of the Power Supply into place under the Power PCA, aligning the notch in the plastic frame with the tab on the PCA.
   c. Press the Power Module down into position. Be sure it aligns correctly with the raised screw holes in the bottom case.
2. **Connect the Power Supply.**
   a. Connect the 2-pin in-line connector to the Battery PCA; be sure it latches.
   b. Connect the 6-pin connector to the Power PCA; be sure it latches.
   c. Connect the 4-pin connector to the Power PCA; be sure it latches.

3. **Replace the Defibrillator Capacitor**

   Restore the Defibrillator Capacitor to its original position on the Power PCA.

4. **Replace the screws.**

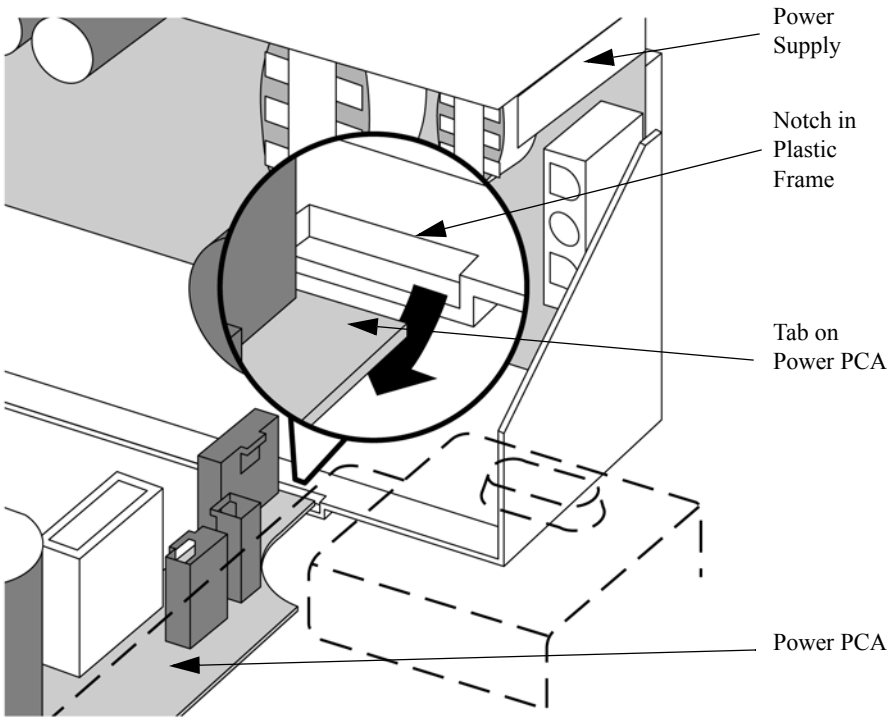
   a. Mate the two case halves together.

   b. Flip the unit over bottom side up.

   c. Replace the two T15 screws and tighten.

   d. Flip the unit rightside up and unmate the case halves.

Figure 4-55 Replacing the Power Supply



After Repair

After repairs are complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Patient Connector

The following sections describe how to remove and replace the Patient Connector. The Patient Connector is where the paddles or the pads cable connect to the M4735A.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

Removal

1. **Disconnect the Patient Connector from the Power PCA.**

   a. Disconnect the 9-pin connector; press on the latch to release. See Figure 4-50 on page 4-109.

   b. Disconnect the two High Voltage spade connectors by pulling up with a needle nose pliers. Note they are different sizes.

2. **Remove the Patient Connector.**

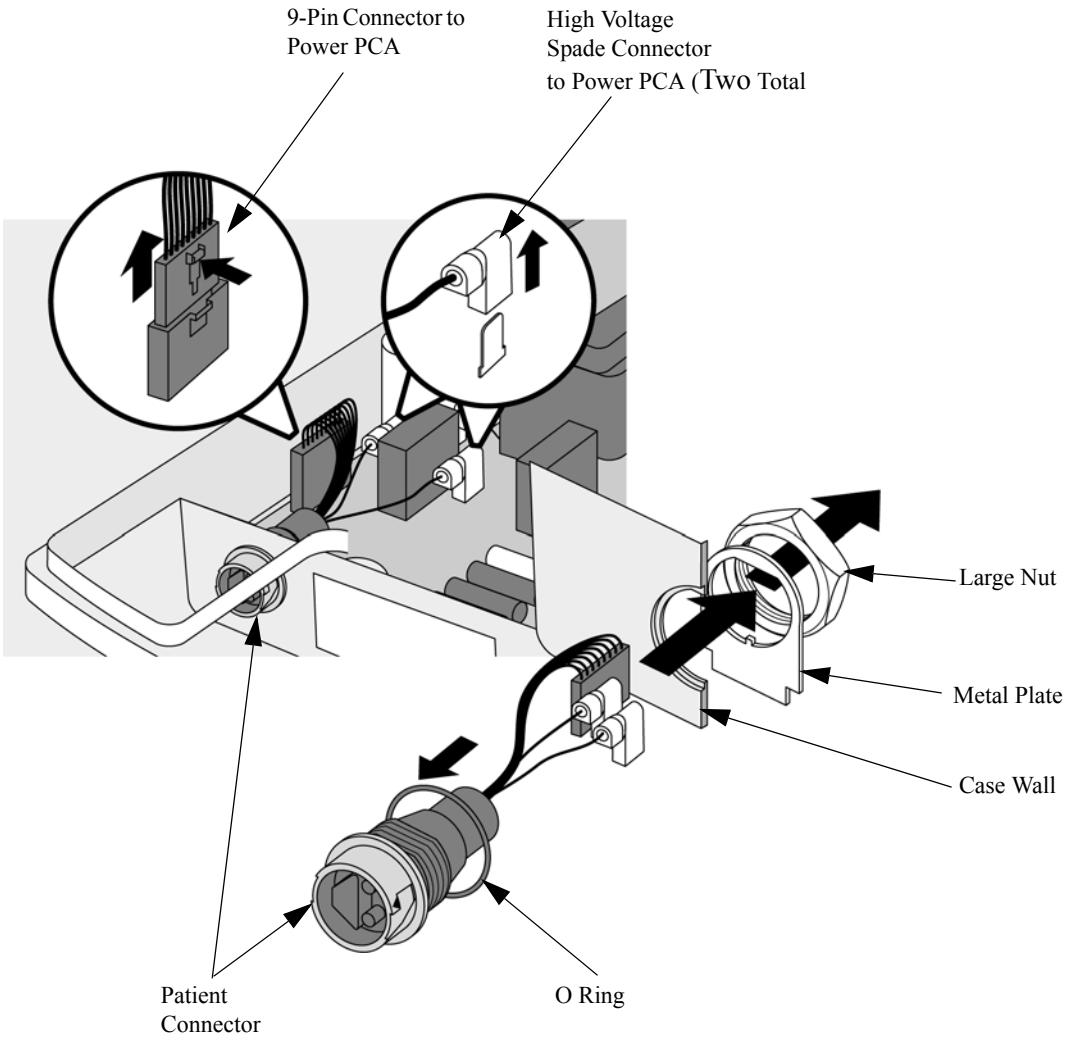
   a. Unscrew the large nut on the back of the connector using a wrench or pliers.

   b. Pull the connector and its wires and O-ring out of the case.

   TIP: Turn the 9-pin connector ***sideways*** to guide it out through the nut and through the hole in the case.

   c. Leave the metal plate in place on the inside of the hole.

Figure 4-56 Removing the Patient Connector



Replacement

1. **Replace the Patient Connector.**

   a. Slide the wires of the new connector through the new O-ring that came with the connector. Seat the O-ring on the connector.

   b. Insert the wires through the hole in the case, and then through the metal plate. Finally, guide them though the large nut. Use the existing nut and plate.

   c. Align the flat section on the connector with the flat portion of the case hole.

   d. Push the connector into the hole, seating the O-ring into the recess in the case.

   e. Tighten the large nut snugly but not excessively. The goal is to compress the O-ring, not crush it hard against the case.

2. **Connect the Patient Connector to the Power PCA.**

   a. Connect the 9-pin connector; be sure it latches.

   b. Connect the two High Voltage spade connectors by pushing straight down with a needle nose pliers.

NOTE The two spade connectors are different sizes to ensure correct connection.

After Repair

After repairs are complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Replacement Bottom Case

The following sections describe how to remove and replace the Bottom Case Assembly.

Description

The Bottom Case Assembly consists of the following components, all preassembled into the case at the factory.

- Data Card Door.
- Battery Eject Latch mechanism
- Case gasket.
- Plug and O-ring for the hole in the front of the case.
- Rubber feet on the bottom.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-26.

   - Data Card Door gasket.

Removal and replacement

The Bottom Case replacement involves:

- Several existing parts which need to be moved from the old case to the new.
- Several new parts which must be installed, and
  - some come with the bottom case.
  - some must be ordered separately.

Parts to be moved from old bottom case to new

The following subassemblies must be removed from the old bottom case and installed into the new one. Follow the Removal and Replacement instructions in this chapter for each subassembly. Remove them in the order shown, and replace them in reverse order.

1. Battery PCA, spring, cable (see "Battery PCA" on page 4-102).
2. Battery eject spring (see "Battery PCA" on page 4-102).
3. Patient Connector, cables, hardware (see "Patient Connector" on page 4-118).
4. Defibrillator capacitor (see "Defibrillator Capacitor" on page 4-106).

5. Power PCA and shield (see "Power PCA" on page 4-108).
6. Power Supply (see "Power Supply" on page 4-112).
7. Battery.
8. All screws.

New parts to be installed - provided with bottom case

The Replacement Bottom Case Assembly comes with the following new components, which must be installed in the field.

- Battery cover.
- Large nut (for Patient Connector).

New parts to be installed - must be ordered separately

In addition, the following parts cannot be reused from the old case, and must be ordered separately and installed into the new bottom case:

- Case Label Set

  These are available in all the supported languages. See the "Replacement Parts" chapter, 5-11 to select the correct language.

- Primary Label

  When replacing the bottom case, the Primary Label containing the unit's serial number must also be replaced. Be prepared to provide information identifying the unit when ordering the bottom case.

NOTE

To enable device tracking as mandated by US Federal law, the Primary Label must be applied before placing the unit back into service.

After Repair

After repairs are complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-123.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit as needed. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Closing the Case

To close the case:

1. **Recheck connections.**

   Recheck connections to all PCAs. Be sure all connectors are fully seated and latched.

2. **Make the unit ready for assembly.**

   a. Make sure the Data Card ejector button is pressed in fully.

   b. Orient the unit flat on a smooth surface so that the handle is closest to you, with the bottom case on the left next to the top case. See Figure 4-17 on page 4-31.

   c. Pivot the top case to a vertical position as shown in Figure 4-16.

3. **Connect the case halves.**

   a. Connect the large ribbon cable from the Power PCA to the Control PCA.

   b. Connect the single wire from the Keyscan PCA to the Power PCA. Push straight down with needle nose pliers.

   c. Connect the AC input to the Power Supply by pushing the connector straight into the Module.

4. **Mate the case halves.**

   a. Flip the top case over to the left into a rightside-up position over the bottom case.

   b. Lower the top case straight down, with the front edge first to give extra room for the ejector button.

   c. Mate top to bottom.

5. **Check the unit.**

   a. Check carefully around all mating edges of the case for any gaskets, wires, etc., sticking out between the case halves.

   b. Turn the case upside down (holding the halves together with your hands) and shake it to double check for loose hardware inside.

   c. Look into the screw holes at the back corners of the case (where the tall case standoffs are located). Check that the screw holes in the standoffs line up with the screw holes in the case.

d. Check to be sure the back corners of the case are properly mated. If one corner won't mate, check to be sure the case standoffs are in their correct locations.

NOTE

The two case standoffs are different colors - the gray standoff should be near the ECG connector, and the yellow standoff near the AC Mains connector. They are slightly different lengths and are ***not*** interchangeable.

6. **Replace the case screws.**

   a. Place the unit on the work surface upside down.

   b. Replace the 1 T15 case screw located in the battery compartment.

   c. Replace the Battery Cover as described in "Battery Cover" on page 4-11.

   d. Turn the unit over rightside up.

   e. Install a battery. If the battery does not readily latch into place, check for a case screw or other hardware lodged against the Battery PCA. Also check that the Battery PCA is installed correctly.

   f. Turn on power and run an Extended Self Test before installing the rest of the case screws (see "Extended Self Test" on page 2-24).

   g. Remove the battery.

   h. Turn the case over and replace the remaining nine T15 screws in their holes and tighten snugly.

7. **Restore the customer's configuration.**

   If you have not already done so, enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit as needed. See "Configuration Mode" on page 2-10.

8. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

5 Replacement Parts

Overview

This chapter provides the part numbers for all replaceable assemblies and sub-assemblies.

Chapter Contents

The major sections of this chapter are as follows:

Ordering Replacement Parts

To order replacement parts:

- In the US, call **888-561-5018.**
- Outside the US, contact your local Philips Medical Systems office.

Ordering Supplies and Accessories

To order accessories and supplies:

- In the US, visit our Medical Systems website at: www.medical.philips.com/cms and follow the links to Supplies
- In the US, call **800-225-0230.**
- Outside the US, contact your local Philips Medical Systems Sales Office, or your authorized Philips Medical Systems Dealer or Distributor.

Key Components

Replacement assemblies marked with an asterisk (*) contain one or more Key Components. Key Components require detailed tracking, by recording the key component part number and either the key component's date code or its serial number. This data must be recorded for both the failed assembly and the replacement assembly.

Philips Medical Systems service personnel must record this information on the Customer Service Order (CSO).

The Key Components that are part of the replacement assemblies are listed in Table 5-18 on page 5-22.

Special Tools

The following special tools are available for purchase from Philips Medical Systems. To order these special tools, contact Philips Medical Systems as described in "Ordering Replacement Parts" on page 5-1.

Tool	Part Number
Torx driver kit	5181-1933
High voltage discharge tool	M2475-69572
Language Support Tool	See Table 5-2 on page 5-6

M4735A Unit Exchange Program

(US and Canada Only)

For customers taking advantage of the M4735A Unit Exchange program, following are notes on logistics and a list of the available Exchange Units.

Logistics

- Philips ships a replacement unit to the customer. This unit does ***not*** include paddles, cables, sensors, accessories, battery, data card, or consumables.
- Customer takes the exchange unit out of the box, tests it, and puts it into service.
- Customer removes all paddles, cables, sensors, accessories, battery, data card, and consumables from defective unit.
- Customer cleans and decontaminates the defective unit.
- Customer packs the defective unit into the box and ships it to Philips Medical Systems. Return shipping instructions are included with the exchange unit.

Table 5-1 M4735A Unit Exchange Part Numbers

Description	Part Number
M4735A Base Unit - American English	M4735-68900
M4735A Base Unit - French	M4735-68901
M4735A Base Unit w/Pacing - American English	M4735-68910
M4735A Base Unit w/Pacing - French	M4735-68911
M4735A Base Unit w/SpO_2 - American English	M4735-68920
M4735A Base Unit w/SpO_2 - French	M4735-68921
M4735A Base Unit w/SpO_2 and Pacing - American English	M4735-68930
M4735A Base Unit w/SpO_2 and Pacing - French	M4735-68931

Replacement Parts Tables

These tables provide part numbers for ordering specific replacement assemblies and parts.

Electrical Assemblies

The following tables provide information about replacement electrical assemblies.

Control PCA

The replacement Control PCA includes the Lithium backup battery, the battery's cable tie wrap, and the black plastic shield for the Data Card receptacle entrance.

All Control PCAs are American English, part number M4735-68100. Use the appropriate Language Support tool to set the Control PCA to the correct language and software release. If you are repairing a device, install the same software release that is already on the device. However, if you are installing a new SpO_2 PCA, you must install the current software release. See "SpO2 PCA" on page 4-78 for more information.

NOTE

The Control PCA is a key component which requires tracking. See Table 5-18 on page 5-22.

Table 5-2 Language Support Tool

Language	Part Number
American English	M4735-87900
French	M4735-87901
German	M4735-87902
Dutch	M4735-87903
Spanish	M4735-87904
Italian	M4735-87905
Swedish	M4735-87906
Japanese	M4735-87907
Norwegian	M4735-87908
Finnish	M4735-87909
Chinese	M4735-87911
Portuguese	M4735-87913
Russian	M4735-87914
Polish	M4735-87919
British English	M4735-87930
Australian English	M4735-87940
8 MB card for SoftServer use	M3510-87890

Other Replacement PCAs

These PCAs come with specific parts as noted.

Table 5-3 Other Replacement PCAs

Description	Part Number	Notes
Power PCA with Pacing	M4735-68110 *	
Power PCA without Pacing	M4735-68111 *	
Keyscan PCA	M4735-66120 * M4735-66125 *	For devices with EL Display For devices with LCD Display
SpO_2 PCA	M4735-66126	
Parameter PCA	M4735-66140 *	Includes standoffs for SpO_2 PCA.
Battery PCA	M3500-66130 *	Includes spring, cables, Main Fuse.

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Other Electrical Assemblies

These assemblies come with specific parts as noted.

Identifying the Display Type

NOTE

The HeartStart XL supports two types of Display assemblies, EL or LCD. If the device has an LCD Display, an "LCD Display" label appears on the primary label (located on the bottom case). Additionally, devices with serial numbers US001XXXXX and US002XXXXX will have an EL Display. Devices with US003XXXX may have either and you will need to check the label. Devices with US004XXXXX will have an LCD Display. It is important to note the Keyscan PCA is different depending on the Display type.

Table 5-4 Other Electrical Assemblies

Description	Part Number	Notes
Printer Assembly	M4735-68520	
Printer Door Kit	M4735-64521	Contains one sliding door, one pivot door, one right spring and one left spring.
Display Assembly	M4735-66552 * M4735-66557 *	For devices with EL Display For devices with LCD Display

Table 5-4 Other Electrical Assemblies

Description	Part Number	Notes
Defibrillator Capacitor Assembly	M3500-69564 *	
Speaker Assembly	M3500-69552	Includes speaker, cable.
Power Supply	M4735-66020 *	
Energy Select Switch Assembly	M4735-66564 *	Also order Knob, M4735-69565.
External Paddles with PCI (English)	M4746-69100 *	
External Paddles with PCI (French)	M4746-69101 *	
External Sterilizable Paddles	M4745-69120 *	
External Paddles with PCI (no language)	M4746-69001 *	Order language-specific label (See Table 5-15 on page 5-22.)

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Individual Electrical Parts

These electrical parts are available separately.

Table 5-5 Individual Electrical Parts

Description	Part Number	Notes
Lithium Battery Replacement Kit	M3500-69565	Includes battery, ProGold wipes, and cable tie wrap
Main Fuse (25A, 32V)	2110-0250	Package of 1

Mechanical Assemblies

The following tables provide information about replacement mechanical assemblies.

Bezel Assembly

The Bezel Assembly comes with the Main Keypad and the display window installed.

Table 5-6 Replacement Bezel Assembly

Language	Part Number
English	M4735-66400 *
French	M4735-69401 *
German	M4735-69402 *
Dutch	M4735-69403 *
Spanish	M4735-69404 *
Italian	M4735-69405 *
Swedish	M4735-69406 *
Japanese	M4735-69407 *
Norwegian	M4735-69408 *
Finnish	M4735-69409 *
Chinese	M4735-69411 *
Portuguese	M4735-69413 *
Russian	M4735-69414 *
Polish	M4735-69419 *

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Pacer Keypad Assembly

Each assembly below contains both the membrane switches and the rubber overlay.

Table 5-7 Replacement Pacer Keypad Assembly

Language	Part Number
English	M4735-69500 *
French	M4735-69501 *
German	M4735-69502 *
Dutch	M4735-69503 *
Spanish	M4735-69504 *
Italian	M4735-69505 *
Swedish	M4735-69506 *
Japanese	M4735-69507 *
Norwegian	M4735-69508 *
Finnish	M4735-69509 *
Chinese	M4735-69511 *
Portuguese	M4735-69513 *
Russian	M4735-69514 *
Polish	M4735-69519 *
Replacement Blank Pacer Cover (Rubber overlay only - for units without Pacing)	M4735-69540

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Other Mechanical Assemblies

These assemblies come with specific parts as noted.

Table 5-8 Other Mechanical Assemblies

Description	Part Number	Notes
Data Card Door Assembly	M4735-69560	Includes door, latch, pivot/spring assembly.
Paddle Holder Assembly	M4735-69561	Includes plastic retainer, metal clip, screws.
Note: The metal clip is also available separately by ordering part number M4735-40019.		
Battery Eject Assembly	M3500-69561	Includes catch, button, spring.
Top Case Assembly	M4735-69551	Includes Speaker Label, Branding Label, Hex Standoffs (for Keyscan PCA), Case Standoffs, Printer cable, IRDA lens; and ECG/SpO_2 hole plug, retainer clips, and gaskets.
Bottom Case Assembly	M4735-69550	Includes Data Card Door, Battery Cover, Battery Eject Mechanism, Hole Plug with gasket, case gaskets, rubber feet.
Note: When ordering the Bottom Case, be sure to order the Primary Label as well. When ordering, be prepared to provide ***all*** the information from the existing label (model number, serial number, options, etc.), plus customer information (name, address), and information identifying the service person (name, address).		

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Connector Assemblies

These replacement connectors come with specific parts as noted.

Table 5-9 Replacement Connector Assemblies

Description	Part Number	Notes
ECG Connector Assembly	M4735-69553	Includes connector, gasket, retainer clip, cable and ferrite.
SpO_2 Connector Assembly	M4735-69554	Includes connector, gasket, flex cable, retainer clip.
Patient Connector Assembly	M3500-69562 *	Includes connector, O-ring, internal cables.
ECG Out/AC Mains Assembly	M4735-69563	Includes ECG Out connector, AC Mains connector, cables.

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Individual Mechanical Parts

These mechanical parts are available separately.

Table 5-10 Individual Mechanical Parts

Description	Part Number	Notes
Cable Tie Wrap	1400-0577	Used to secure Lithium Battery to Control PCA.
T10 (M3X0.5) screw	0515-0375	Long screw used to connect the paddle wires from the Keyscan PCA to the through-case connection to the Paddle Clip.
T10 nut	0535-003	Used to secure the T10 screw (0515-0375).
T10 (M3X6) screws	0515-0430	Used for battery cover, interior assemblies, PCAs. Also used outside the case to connect the Paddle Clip to the through-case connection to the Keyscan PCA.
T10 (M3X20) screws	0515-1410	Long screws used for securing Parameter PCA to top case. If SpO_2 installed, secures SpO_2 PCA to Parameter PCA.
T15 (M4) flat head screws	0515-2044	Used only for securing paddle holder to case.
T15 (M4X10) screws	0515-0380	Used for case exterior.
Rubber Feet	M4735-69562	Includes 4 feet.
Energy Select Knob	M4735-69565	Includes metal retainer clip inside shaft hole.
Metal Clip	M4735-40019	Metal contact clip for paddles. Also supplied with Paddle Holder Assembly (M4735-69561).
Hooded plastic shield	M4735-49021	Used with Parameter PCA

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Labels

The labels used on the M4735A are divided into 4 groups: the Instruction Label Set, the Case Label Set, the Branding Label Set, and the Speaker Label. Each set of labels is one sheet containing all the labels in that set.

For details of which label is part of which set, see "Labels" on page 4-22.

Instruction Label Sets

The Instruction Label Set is available for units both ***with*** and ***without*** pacing, in the following supported languages. See Figure 4-10 on page 4-23 for correct placement of these labels.

Table 5-11 Instruction Label Sets - *Without* Pacing

Language	Part Number
English	M4735-69600
French	M4735-69601
German	M4735-69602
Dutch	M4735-69603
Spanish	M4735-69604
Italian	M4735-69605
Swedish	M4735-69606
Japanese	M4735-69607
Norwegian	M4735-69608
Finnish	M4735-69609
Chinese	M4735-69611
Portuguese	M4735-69613
Russian	M4735-69614
Polish	M4735-69619

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Table 5-12 Instruction Label Sets - *With* Pacing

Language	Part Number
English	M4735-69700
French	M4735-69701
German	M4735-69702
Dutch	M4735-69703
Spanish	M4735-69704
Italian	M4735-69705
Swedish	M4735-69706
Japanese	M4735-69707
Norwegian	M4735-69708
Finnish	M4735-69709
Chinese	M4735-69711
Portuguese	M4735-69713
Russian	M4735-69714
Polish	M4735-69719

Items marked with an asterisk (*****) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Case Label Sets

The Case Label Set is available for units both ***with*** and ***without*** SpO_2, in the following supported languages. See Figure 4-10 on page 4-23 for correct placement of these labels.

Table 5-13 Case Label Sets - *Without* SpO_2

Language	Part Number
English	M4735-69800
French	M4735-69801
German	M4735-69802
Dutch	M4735-69803
Spanish	M4735-69804
Italian	M4735-69805
Swedish	M4735-69806
Japanese	M4735-69807
Norwegian	M4735-69808
Finnish	M4735-69809
Chinese	M4735-69811
Portuguese	M4735-69813
Russian	M4735-69814
Polish	M4735-69819

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Table 5-14 Case Label Sets - *With* SpO_2

Language	Part Number
English	M4735-69820
French	M4735-69821
German	M4735-69822
Dutch	M4735-69823
Spanish	M4735-69824
Italian	M4735-69825
Swedish	M4735-69826
Japanese	M4735-69827
Norwegian	M4735-69828
Finnish	M4735-69829
Chinese	M4735-69831
Portuguese	M4735-69833
Russian	M4735-69834
Polish	M4735-69839

Items marked with an asterisk (**) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Paddle Labels

Order one of the language-specific labels listed in this table for use with the External Paddles with PCI (M4746-69001).

Table 5-15 Paddle Labels

Language	Part Number
English	M1722-84520
French	M1722-84521
German	M1722-84522
Dutch	M1722-84523
Spanish	M1722-84524
Italian	M1722-84525
Swedish	M1722-84526
Japanese	M4735-85117
Norwegian	M1722-84560
Finnish	M1722-84561
Chinese	M4735-85111
Portuguese	M4735-85113
Russian	M4735-85114
Polish	M4735-85119

Other Labels

These labels are also available. See Figure 4-12 on page 4-24 for correct placement of these labels.

Table 5-16 Other Labels

Description	Part Number	Notes
Speaker Label Set	M4735-69555	
Branding Label Set	M4735-69556	

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Supplies & Accessories

Approved supplies and accessories for the M4735A are listed in . To order accessories and supplies:

- Visit our Medical Systems website at: www.medical.philips.com/cms and follow the links to Supplies
- In the US, call **800-225-0230.**
- Outside the US, contact your local Philips Medical Systems Sales Office, or your authorized Philips Medical Systems Dealer or Distributor.

Table 5-17: Upgrades, Supplies, and Accessories

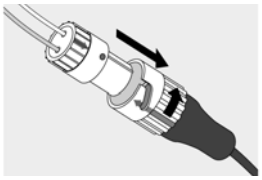
Part Number	Description
Upgrades	
M4738A	Pacing Upgrade
M4739A	SpO_2 Upgrade
Defibrillation Pads, Pads Cables and Test Load (white twist lock connector)	
M3501A	Multifunction Adult defib pads, AAMI.
M3502A	Multifunction Adult defib pads, IEC.
M3503A	Multifunction Pediatric defib pads, IEC.
M3504A	Multifunction Pediatric defib pads, AAMI.
M3507A *	Defib pads cable, barrel connector.
M1781A	50 ohm defibrillator test load, barrel connector
05-10200	HeartStart Pads Adapter, barrel connector. Connects to M3507A pads connector cable.

Table 5-17: Upgrades, Supplies, and Accessories *(Continued)*

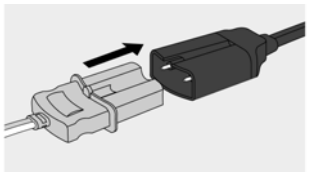
Part Number	Description
Defibrillation Pads, Pads Cables, Adapters and Test Load (gray flat connector)	
M3713A	Multifunction Adult Plus Pads - Adult Plus multifunction defib pads (general use).
M3716A	Multifunction Adult Radiolucent Pads - Adult Radiolucent multifunction defib pads (special purpose - for X-ray and special procedures).
M3717A	Multifunction Pediatric Plus Pads - Pediatric multifunction defib pads (general use).
M3718A	Multifunction Adult Radiotransparent/Reduced Skin Irritation Pads - Adult Radiotransparent/Reduced Skin Irritation multi-function defib pads (special purpose - for X-ray and special procedures).
M3719A	Multifunction Pediatric Radiotransparent/Reduced Skin Irritation Pads - Pediatric Radiotransparent/Reduced Skin Irritation multifunction defib pads (special purpose - for X-ray and special procedures).
M3508A *	Defibrillator pads cable, plug connector.
M3725A	50 ohm defibrillator test load, plug connector.
Paper	
40457C	50 mm Strip Chart Thermal Paper -1 box (10 rolls)
40457D	50 mm Strip Chart Thermal Paper -1 box (80 rolls)
External Paddles	
M4745A *	Sterilizable External Paddles with PCI
M4746A *	External Paddles with PCI
M1789A	Replacement Adult Paddle Electrode (clips onto external paddle)

Table 5-17: Upgrades, Supplies, and Accessories *(Continued)*

Part Number	Description
Internal Paddles (Switched/Switchless)	
M1741A *	7.5 cm Switchless Internal Paddles
M1742A *	6.0 cm Switchless Internal Paddles
M1743A *	4.5 cm Switchless Internal Paddles
M1744A *	2.8 cm Switchless Internal Paddles
M4741A *	7.5 cm Switched Internal Paddles
M4742A *	6.0 cm Switched Internal Paddles
M4743A *	4.5 cm Switched Internal Paddles
M4744A *	2.8 cm Switched Internal Paddles
M4740A *	Internal Paddles Adapter Cable
ECG Cables	
M1500A	3-lead ECG Trunk Cable (AAMI)
M1510A	3-lead ECG Trunk Cable (IEC)
M1520A	5-lead ECG Trunk Cable (AAMI)
M1530A	5-lead ECG Trunk Cable (IEC)
Sync Cable	
M1783A	12-pin Sync Cable
SpO_2 Cables/Sensors	
M1191A	Adult Reusable SpO_2 Sensor
M1192A	Pediatric Reusable SpO_2 Sensor
M1194A	Adult/Pediatric Ear Clip, Reusable SpO_2 Sensor
M1131A	Adult/Pediatric Disposable SpO_2 Sensor (length = 45cm)
M1903B	Disposable SpO_2 Sensor - Pediatric Finger (Available outside the U.S. only)
M1904B	Disposable SpO_2 Sensor - Adult Finger (Available outside the U.S. only)
M1941A	SpO_2 2-meter extension cable
M1943A	Nellcor SpO_2 Sensor Adapter Cable

Table 5-17: Upgrades, Supplies, and Accessories *(Continued)*

Part Number	Description
Monitoring Electrodes	
M2202A	High-Tack Foam ECG Electrodes - 5 electrodes/pouch (300 electrodes/case)
Data Card	
989803147711	Data Card
Battery	
M3516A *	Sealed Lead Acid Battery
M4747A *	Battery Charger Kit
M3506A	Battery charger adapter
Battery Chargers	
989803135291	Cadex C7200 Battery Charger (holds 2 XL batteries)
989803135321	Cadex C7400 Battery Charger (hold 4 XL batteries)
989803135341	Cadex C7400 Battery Charger (hold 2 XL & 2 MRx batteries)
Accessory Pouch	
M4751A	Accessory pouch
Extension Cable	
M4748A	Adapter extension cable
User Training CD-ROM	
M4735-91000	User Training CD-ROM Kit

Items marked with an asterisk (*) contain Key Components which require tracking. See Table 5-18 on page 5-22.

Key Components

Key components require tracking as indicated below. Record the Part Number and either the Date Code or Serial Number for both the failed component and the replacement component.

Table 5-18 Key Components

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
ELECTRICAL ASSEMBLIES				
Control PCA		Control PCA	M4735-68100	Serial Number
Power PCA				
With Pacing	M4735-68110	Power PCA	M4735-61110	Serial Number
Without Pacing	M4735-68111	Power PCA	M4735-61111	Serial Number
Other Replacement PCAs				
Parameter PCA	M4735-66140	Parameter PCA	M4735-61140	Serial Number
Keyscan PCA	M4735-66120	Keyscan PCA - EL Display	M4735-61120	Serial Number
Keyscan PCA	M4735-66125	Keyscan PCA - LCD Display	M4735-60125	Serial Number
Battery PCA	M3500-66130	Battery PCA	M3500-60130	Date Code
Other Electrical Assemblies				
Display Assembly	M4735-66552	Display Assembly - EL Display	2090-0803	Serial Number
Display Assembly	M4735-66557	Display Assembly - LCD Display	M4735-60996	Serial Number
Defibrillator Capacitor Assembly	M3500-69564	Defibrillator Capacitor	010879-0004	Serial Number ***and*** Date Code
Power Supply	M4735-66020	Power Supply	M4735-60020	Date Code
Energy Select Switch Assembly	M4735-69564	Switch Assembly	M4735-60018	Date Code
External Paddles with PCI (English)	M4746-69100	External Paddles with PCI (English)	M4746-69100	Date code
External Paddles with PCI (French)	M4746-69101	External Paddles with PCI (French)	M4746-69101	Date code
External Sterilizable Paddles	M4745-69120	External Sterilizable Paddles	M4745-69120	Date code
External Paddles with PCI (no language)	M4746-69001	External Paddles with PCI (no language)	M4746-69001	Date code

Table 5-18 Key Components *(Continued)*

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
MECHANICAL ASSEMBLIES				
Bezel Assembly		Main Keypad Switch Assembly	M4735-60200	Date Code
English	M4735-69400			
French	M4735-69401			
German	M4735-69402			
Dutch	M4735-69403			
Spanish	M4735-69404			
Italian	M4735-69405			
Swedish	M4735-69406			
Japanese	M4735-69407			
Norwegian	M4735-69408			
Finnish	M4735-69409			
Chinese	M4735-69411			
Portuguese	M4735-69413			
Russian	M4735-69414			
Polish	M4735-69419			

Table 5-18 Key Components *(Continued)*

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
Pacer Keypad Assembly		Pacer Keypad Switch Assembly	M4735-60210	Date Code
English	M4735-69500			
French	M4735-69501			
German	M4735-69502			
Dutch	M4735-69503			
Spanish	M4735-69504			
Italian	M4735-69505			
Swedish	M4735-69506			
Japanese	M4735-69507			
Norwegian	M4735-69508			
Finnish	M4735-69509			
Chinese	M4735-69511			
Portuguese	M4735-69513			
Russian	M4735-69514			
Polish	M4735-69519			
Connectors				
Patient Connector Assembly	M3500-69562	Patient Connector Assembly	M3500-62601	Date Code
SUPPLIES & ACCESSORIES				
External Defibrillation Paddles				
External Sterilizable Paddles	M4745A	External Sterilizable Paddles	M4745A	Date Code
External Paddles with PCI	M4746A	External Paddles with PCI	M4746A	Date Code

Table 5-18 Key Components *(Continued)*

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
Internal Defibrillation Paddles				
7.5 cm Switchless Internal Paddles	M1741A	7.5 cm Switchless Internal Paddles	M1741A	Date Code
6.0 cm Switchless Internal Paddles	M1742A	6.0 cm Switchless Internal Paddles	M1742A	Date Code
4.5 cm Switchless Internal Paddles	M1743A	4.5 cm Switchless Internal Paddles	M1743A	Date Code
2.8 cm Switchless Internal Paddles	M1744A	2.8 cm Switchless Internal Paddles	M1744A	Date Code
7.5 cm Switched Internal Paddles	M4741A	7.5 cm Switched Internal Paddles	M4741A	Two Date Codes - paddles, connector
6.0 cm Switched Internal Paddles	M4742A	6.0 cm Switched Internal Paddles	M4742A	Two Date Codes - paddles, connector
4.5 cm Switched Internal Paddles	M4743A	4.5 cm Switched Internal Paddles	M4743A	Two Date Codes - paddles, connector
2.8 cm Switched Internal Paddles	M4744A	2.8 cm Switched Internal Paddles	M4744A	Two Date Codes - paddles, connector
Internal Paddles Adapter Cable	M4740A	Internal Paddles Adapter Cable	M4740-61601	Date Code
Pads Cables				
Defib Pads Cable, barrel connector	M3507A	Defib Pads Cable, barrel connector	M3507-6007	Date Code
Defib Pads Cable, plug connector	M3508A	Defib Pads Cable, plug connector	M3508-60008	Date Code
Battery/Charger				
Sealed Lead Acid Battery	M3516A	Sealed Lead Acid Battery	1420-0561	Date Code
Battery Charger Kit (Battery Charger Adapter + AC Power Module + Battery)	M4747A	Sealed Lead Acid Battery	1420-0561	Date Code
		AC Power Module	M3517-60000	Date Code

6 Theory of Operation

Overview

This chapter describes the internal operation of the M4735A. This description is at the functional-block level.

The information is presented in two ways:

- **PCA Descriptions**

  For each Printed Circuit Assembly (PCA), a description of the major functions performed on that PCA.

- **System Functional Descriptions**

  For each major system function, a description of how the signal is routed through the various PCAs.

In these descriptions, reference will be made to PCAs or features which are optional and may not be present in the unit you have. In that case, simply ignore those sections. The remaining PCA and Functional descriptions will still apply.

PCA Descriptions

The sections following provide descriptions of the functions handled by each PCA.

Control PCA

The Control PCA performs the following functions:

- System level processing.
- System level control and clock functions, including:
    a. Control of power up and power down sequences.
    b. Storage of configuration selections made by the user.
    c. Storage of operating software, including data for generating display formats and graphics.
- Main interconnection site between the other PCAs.
- User interface functions, including:
    a. Generation and control of tones and audio prompts.
    b. Generation and formatting of real-time information for the display and for the printer.
    c. Control of printer functions.
    d. Control of indicator LEDs for **Sync, Pacer**, **AC Power**, **Batt Charge**.
- Control of data to and from the Data Card.
- Control of defibrillation functions on the Power PCA, including:
    a. Initiating a capacitor charge sequence.
    b. Monitoring charge on capacitor.
    c. Initiating a shock delivery sequence.
- Control of pacing functions on the Power PCA, including:
    a. Starting/stopping pacing.
    b. Controlling Rate and Output as selected by user, and monitoring pacing current delivered.
- Control of the ECG front ends on the Parameter PCA (Leads ECG) and Power PCA (Paddles/Pads ECG).
- Generation and regulation of the 5 volt logic power supply.

Power PCA

The Power PCA performs the following functions:

- Analog front end for ECG from pads.
- Impedance measurement for Paddle Contact Indicator (PCI) function.
- Generation and control of pacing waveforms as directed by Control PCA.
- Control of defibrillator functions as directed by the Control PCA:
    a. Charging the capacitor to the correct energy level.
    b. Delivering the shock and controlling the waveform.
    c. Disarming (discharging) the capacitor.

Parameter PCA

The Parameter PCA performs the following functions:

- Interconnection site for ECG leads cable, ECG out cable and SpO_2 module.
- ECG analog front end for ECG from 3- and 5-lead cables.
- SpO_2 on/off logic and patient isolation.

Keyscan PCA

The Keyscan PCA performs the following functions:

- Interconnection site for:
    a. All front panel keys.
    b. Energy Select Switch.
    c. All front panel LEDs (**Sync, Pacer**, **AC Power**, **Batt Charge**).
    d. IrDA interface.
    e. EL display data and control signals.
- Detecting and initial processing of front panel key presses.
- Pass through of Energy Select Switch signals.
- Interface for IrDA module (used only in manufacturing at this time).
- Pass through of EL display data and control signals.
- Internal test load for paddle discharge.

SpO_2 PCA

The SpO_2 PCA serves as the interface to the SpO_2 sensor, including:

- Generation and control of voltages to drive the LEDs in the sensor.
- Receiving and processing the signals from the SpO_2 sensor.

Battery PCA

The Battery PCA provides the contacts with which the battery mates. It also has the main fuse, and it provides the function of detecting whether the installed battery is an M3516A battery or not (see "Contacts/Battery Type" on page 6-12). It also detects the temperature of the battery.

Battery

The M3516A battery differs from similar batteries in that it is capable of providing much higher current without causing an internal protection device to open and disconnect the battery.

Power Supply

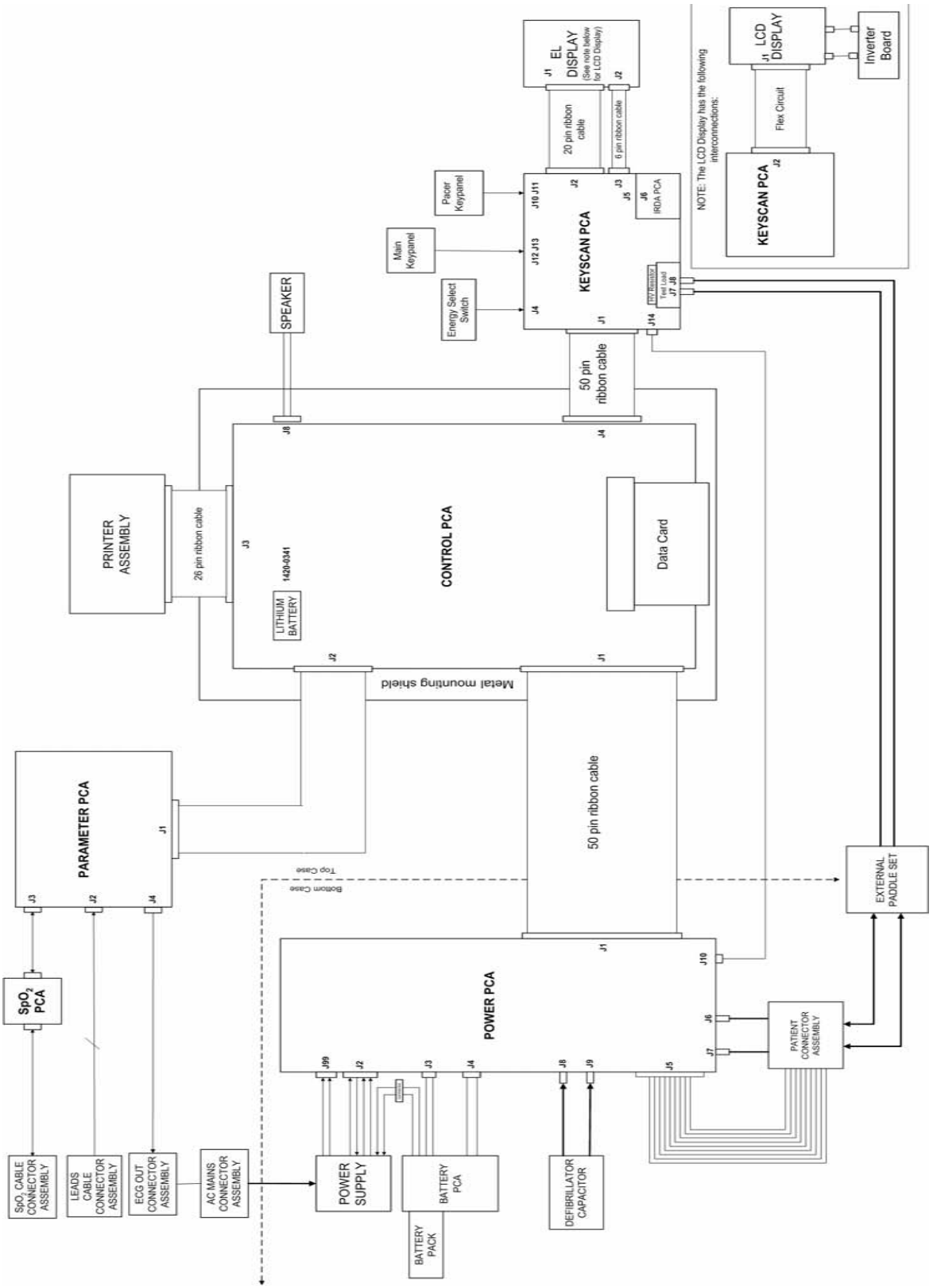
The Power Supply provides regulated DC power to the unit and charges the battery.

Printer

The printer provides hard copy output of text, waveforms, event data, etc. It senses when the paper is out, or the door is left open.

System Level Interconnections

Figure 6-1 System Interconnections



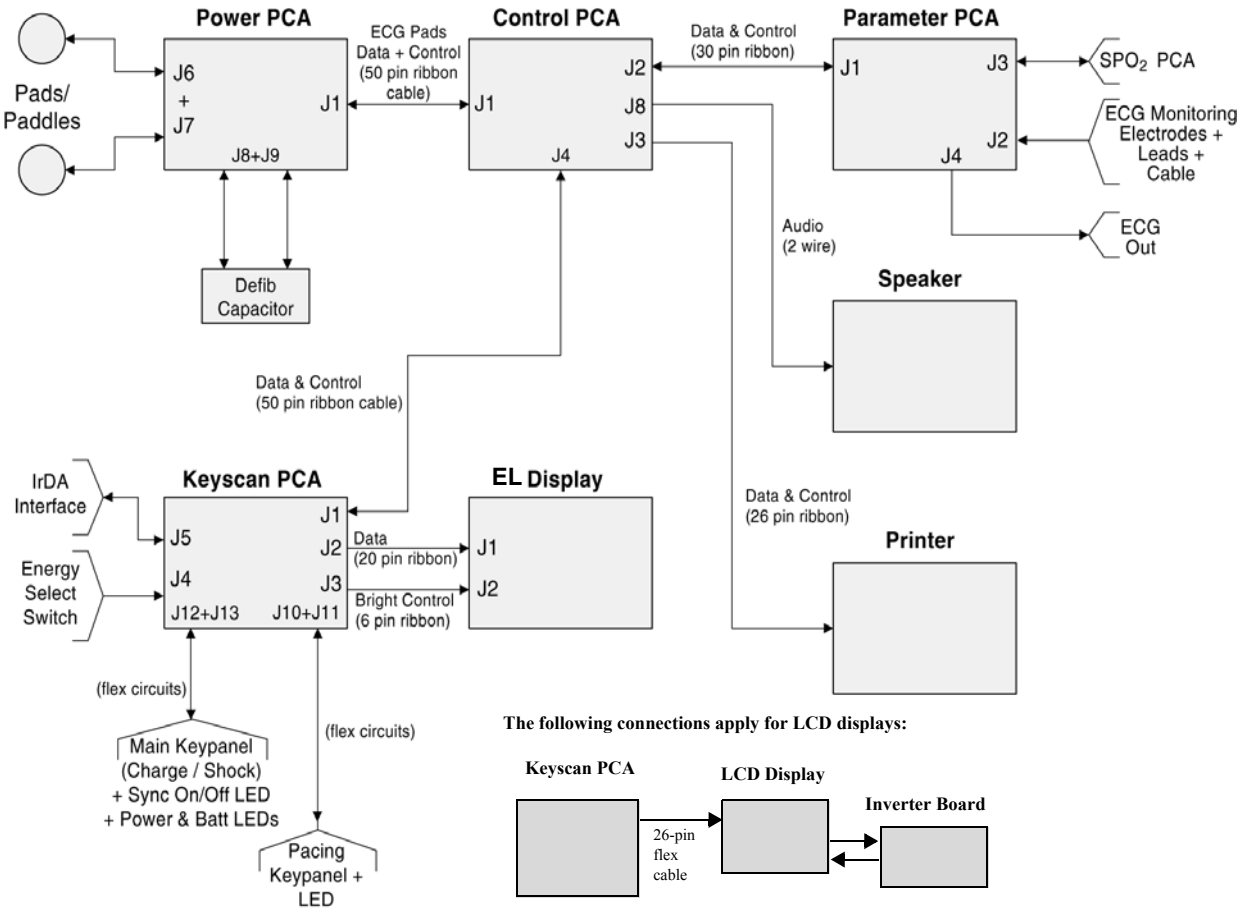
System Functional Descriptions

For all of the descriptions below, refer to Figure 6-2 "Signal and Data Flow".

Signal and Data Flow

Below is a high level block diagram representing how signals and data flow to and from the PCAs.

Figure 6-2 Signal and Data Flow



ECG Monitoring Functions

There are two separate ECG front ends: one for signals coming in on the paddles or pads cable, and one for signals coming in on the 3- or 5-lead ECG cable.

ECG - Paddles/Pads

The ECG signal picked up by the paddles or disposable defibrillation pads is carried by the cable to the pads/paddles connector, and then to the Power PCA. There it is amplified, filtered, digitized and passed across a patient isolation barrier before being passed to the Control PCA via a large ribbon cable.

The Control PCA then performs digital signal processing on the ECG data, and is responsible for:

- ECG waveform analysis and Shock Advisory (in AED Mode).
- Formatting and presenting the ECG to the display and to the printer.
- Counting heart rate and generating heart rate alarms.
- Reporting on the status of the patient connection.

ECG - 3- or 5-lead cable

The ECG signal picked up by the ECG monitoring electrodes is carried by the ECG cable to the ECG connector, and then to the Parameter PCA. There it is amplified, filtered, and digitized before being passed to the Control PCA via a large ribbon cable.

The Control PCA then performs digital signal processing on the ECG data, and is responsible for

- Formatting and presenting the ECG to the display and to the printer.
- Counting heart rate and generating heart rate alarms.
- Reporting on the status of the patient connection, and alerting the user to measurement problems.

Patient impedance functions

The M4735A measures patient impedance in two ways: an ***impedance*** measurement before the shock, and a ***resistance*** measurement during the shock.

Before the Shock

The M4735A makes a small-signal AC impedance measurement (at 32 kHz) in the steady state situation before a shock is delivered. This measurement is used to detect **Pads Off** and **Paddles Off**. It is also used for the Paddle Contact Indicator (PCI) function, in which the quality of the contact the paddles are making with the patient is indicated on an LED bar graph on the Sternum paddle. The unit only displays a numeric value in Diagnostic Mode, as part of the ECG test.

During the Shock

The M4735A also makes a resistance measurement during shock delivery. This resistance is derived from measurements of voltage and current, and is reported on the printed event summary. The unit uses this value to determine whether to abort the shock, or to allow it to complete.

Since one measurement is a small-signal AC measurement of impedance and the other is a high-voltage/high-current measurement of resistance, it is normal and expected for the two measurements to produce slightly different numerical results.

SpO_2 Monitoring Functions

The SpO_2 signal from the sensor is carried by the external SpO_2 cable to the SpO_2 connector, and then to the SpO_2 PCA. There it is amplified, filtered, and digitized before being passed to the Parameter PCA via a flex circuit. (Power for the SpO_2 PCA and sensor is provided by the Parameter PCA via this same flex circuit.) The Parameter PCA provides on/off logic, patient isolation, and the power supply for SpO_2. It then sends the data to the Control PCA via a large ribbon cable.

The Control PCA is then responsible for:

- Formatting and presenting the O_2 saturation level, pulse rate and pleth bar to the display.
- Counting pulse rate, generating O_2 saturation level alarms.
- Reporting on the status of the sensor and its connections, and alerting the user to measurement problems.

NOTE

A functional tester (i.e. simulator or safety analyzer) can not be used to assess the accuracy of a SpO_2 probe or an SpO_2 monitor.

Defibrillation Functions

The following sections describe the defibrillation functions.

Charging

There are three basic events that can initiate a charging cycle:

- In AED Mode, when the analysis algorithm determines a shock is needed and sends a signal to another section of the Control PCA.
- In Manual Mode with either pads or paddles, when front panel key #2 (**CHARGE**) is pressed, the keypress is transferred from the key to the Keyscan PCA via a flex circuit. The Keyscan PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA.
- Also in Manual Mode when the Apex paddle **CHARGE** key is pressed, the keypress is transferred from the key to the Power PCA via the paddles cable. The Power PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA

In all cases, the charging cycle is initiated and controlled by the Control PCA. It directs the Power PCA to begin charging the charge capacitor, and it monitors the voltage on the capacitor as reported back by the Power PCA.

When the Control PCA detects that the selected energy (voltage) level has been reached, it directs the Power PCA to stop charging. The Control PCA then continues to monitor the voltage on the capacitor, and as the voltage bleeds down it directs the Power PCA to top up the charge to the correct level.

Should a decision be made to change the selected energy to a lower value, the user would turn the Energy Select Switch to the desired setting. At the lower energy setting, the Control PCA directs the Power PCA to disarm (completely discharge) the capacitor then charge up to the new (lower) level.

If the requested charge is not used within 30 seconds, the Control PCA automatically directs the Power PCA to disarm the capacitor as a safety precaution.

Delivering a shock

The discharging cycle (delivering a shock) is initiated by either of two events.

- The first is by pressing the front panel key #3 (**SHOCK**) when using pads. This keypress is transferred from the key to the Keyscan PCA via a flex circuit. The Keyscan PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA.

- The second means of initiating a shock is by simultaneously pressing the **SHOCK** switches on both the Sternum and Apex paddles. These keypresses are transferred from the keys to the Power PCA via the paddles cable. The Power PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA

In either case, the Control PCA directs the Power PCA to deliver the shock. Patient resistance is derived from the current and voltage delivered during the initial portions of the waveform, and the biphasic waveform is then adjusted as needed to deliver the correct energy.

The Power PCA will abort delivery of the shock if any of the following occurs:

- During the impedance measurement, the impedance is outside of operating limits (too high or too low).
- At any time during delivery of the shock, it detects an open circuit (voltage too high for that point in the waveform) or a short circuit (current too high for that point in the waveform).

Should any of these conditions be detected, the Power PCA terminates delivery of the waveform and disarms the capacitor. The problem is reported to the Control PCA, which displays and/or prints the appropriate messages.

Another safety feature is the presence of an identification resistor in the pads and paddles cables. If the unit does not sense that resistance, it gives a **Cable Off** message and will not charge the capacitor.

Delivering synchronized cardioversion

Synchronized cardioversion operates the same as delivering a shock, except that the shock must be synchronized to the R wave of the ECG. The Control PCA is responsible for detecting the R wave and placing markers on the printed strip and on the display to indicate the timing of the proposed cardioversion shock.

A synchronized shock can be delivered in either of two ways:

- First, when using pads, by pressing and holding key #3 (**SHOCK**) until the next time an R wave is detected.
- Second, by simultaneously pressing and holding the **SHOCK** switches on both the Sternum and Apex paddles until the next time an R wave is detected.

When both events occur (either type of key press and detection of an R wave) the Control PCA directs the Power PCA to deliver the shock.

Pacing Functions

Pacing is initiated and controlled by pressing front panel keys. These key presses are transferred from the keys to the Keyscan PCA via a flex circuit. The key presses are detected and processed by the Keyscan PCA and then passed to the Control PCA via a large ribbon cable.

The Control PCA directs the Power PCA to deliver the pacing pulses at the rate and output current selected by the user. The pacing pulses are delivered via the pads cable to the defibrillation pads. The pacing current delivered is reported back to the Control PCA, which sends the info to the display and activates any printouts or screen messages as needed.

Audio Functions

The M4735A has two types of audio output: tones, and voice prompts. Both are generated and controlled by the Control PCA, which also amplifies the signals and passes them directly to the speaker via a dedicated connector and wire pair.

Display Functions

All display functions are handled by the Control PCA. Display formats, graphics, waveforms, numeric values, and messages are all generated and formatted by the Control PCA, using either data it has or data it receives from other parts of the unit.

Indicator Functions

All front panel LEDs (**Sync**, **Pacer**, **AC Power** and **Batt Charge**) are controlled by the Control PCA. The LEDs are connected into the Keyscan PCA via flex circuits; they are then routed to the Control PCA via a ribbon cable.

Key Functions

All keys, both on the Main Keypad and on the Pacer Keypad, connect to the Keyscan PCA via flex circuits. Keypresses from all keys are detected and processed by the Keyscan PCA and then passed to the Control PCA via a large ribbon cable. The Control PCA then interacts with the other parts of the system as needed to respond to the keypress.

Energy Select Switch

The Energy Select Switch selects operation in either AED Mode or Manual Mode.

In Manual Mode, energy selection is made by rotating the Energy Select Switch to the appropriate position. The Energy Select Switch signals pass through the Keyscan PCA and then on to the Control PCA via a large ribbon cable. The Control PCA then interacts with the other parts of the system as needed to respond to the setting of the Energy Select Switch.

Printing Functions

All printing data are handled by the Control PCA. Waveforms, graphics, numeric values, and messages are all generated and formatted by the Control PCA, using either data it has or data it receives from other parts of the unit. This data is then passed to the Printer via the printer ribbon cable.

Contrast

The printing contrast is controlled automatically by the Printer itself. The printhead senses its own temperature and impedance, and passes that information to the Control PCA. The Control PCA adjusts drive voltage to the printhead (and thus contrast) based on these readings and on battery voltage.

Out of Paper/Door Open

The printer also incorporates an optical sensor that detects when there is no paper left, or when the printer door is open. The information is passed to the Control PCA via the printer ribbon cable, and the Control PCA generates the appropriate screen message and tones to alert the user.

Battery/Power Functions

Refer to Figure 6-3 on page 6-14 and Figure 6-4 on page 6-15 for the following descriptions.

Power for charging the battery and running the unit is supplied via the Power Supply. The M4735A uses approximately 400 - 650 uA of 12 V DC when powered off to maintain configuration settings, system clock, etc. When powered on in Monitoring Mode, the unit consumes approximately 500 - 700 mA.

Contacts/Battery Type

The battery mates with contacts on the Battery PCA. Power from the battery flows through the Main Fuse on the Battery PCA, and then through separate wires to the Power PCA for distribution to the rest of the unit.

The Battery PCA also detects whether the installed battery is an Philips-approved battery or not. It does this with a microswitch on the battery PCA, which detects if a dimpled recess is present in the end face of the battery. Philips M3516A batteries have this dimple, while other batteries, even those that are otherwise mechanically compatible, do not.

This information is passed via a separate pair of wires to the Power PCA and from there to the Control PCA. During defibrillation, the Control PCA will direct the Power PCA to charge the defibrillator capacitor more slowly if there is a battery other than an M3516A present. This is done to reduce current drain on the battery and thus avoid tripping the thermal cutout present on many other batteries. Philips M3516A batteries do not have this cutout, so their current delivery can be greater, allowing the defibrillator to charge more quickly.

Charging

Monitoring the battery and controlling the charging process are both handled by the Power Supply. The Power PCA receives status information via connections both directly to the Power Supply and to the battery. The Power PCA then sends this status information to the Control PCA via a large ribbon cable. The Control PCA processes this information and sends signals to control the **AC Power** and **Batt Charge** LED's via the Keyscan PCA. When the unit is powered on while AC is connected, the Power PCA instructs the Power Supply to enter “power supply” mode.

Figure 6-3 Power Flow

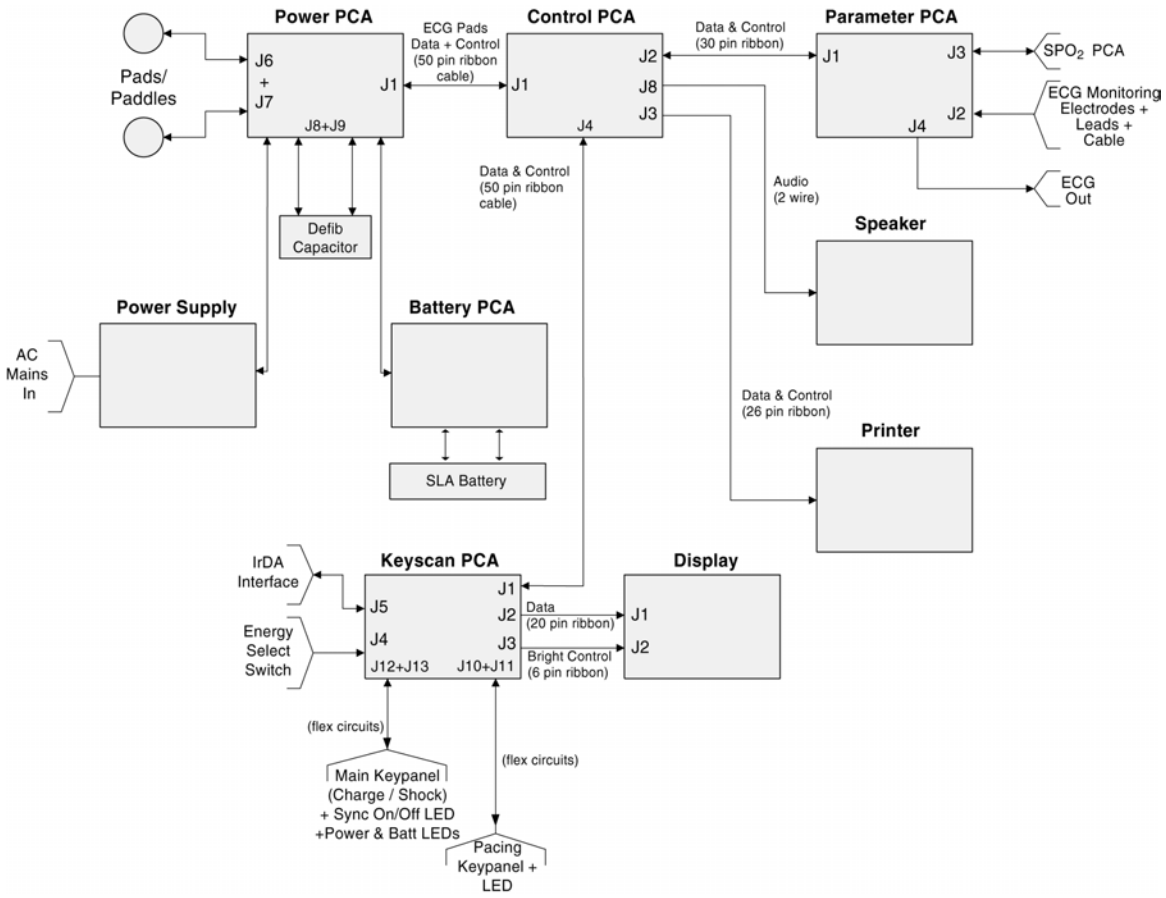
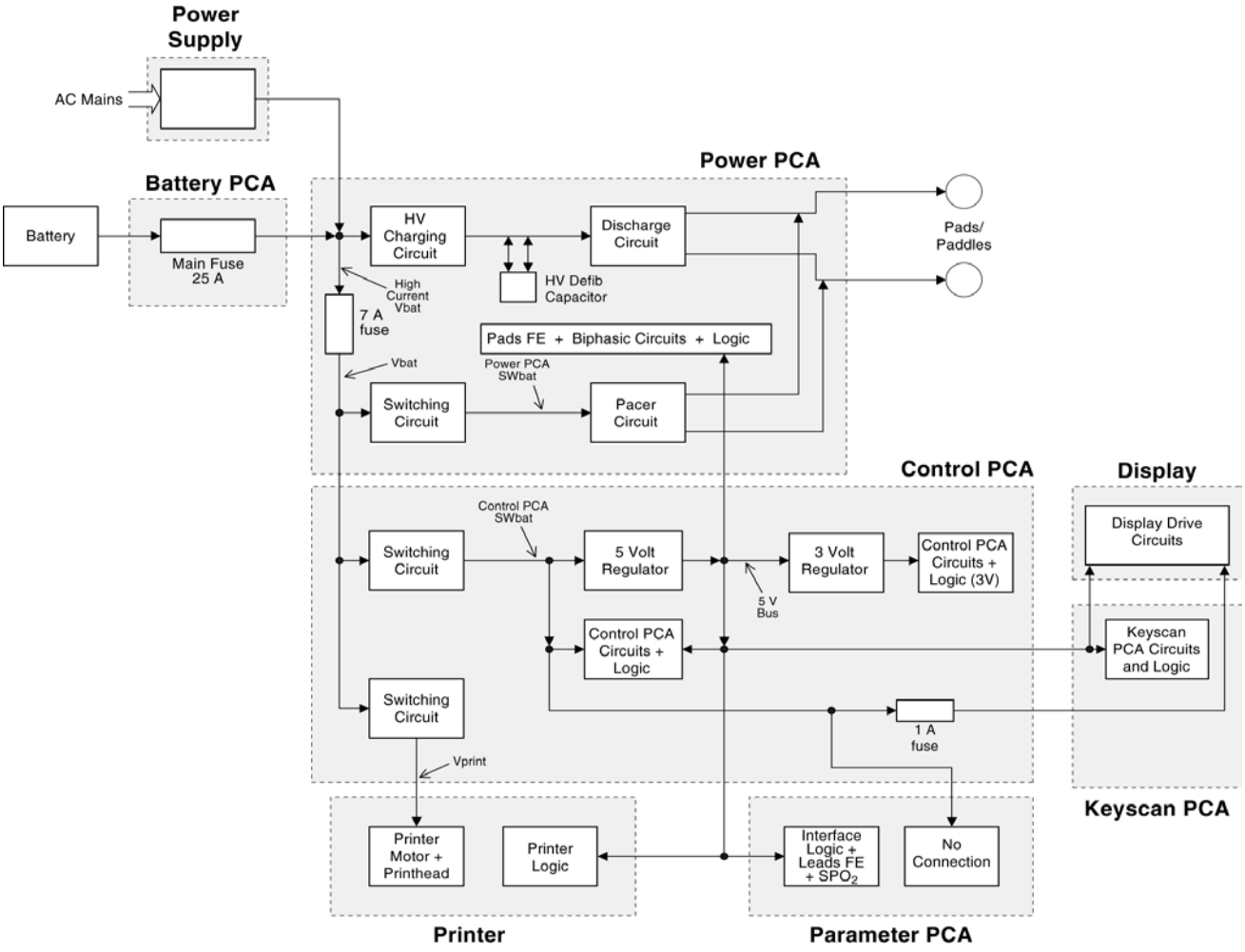


Figure 6-4 Power Distribution and Fusing



Lithium Backup Battery

The Backup Battery (located on the Control PCA) provides standby power to maintain data during times when the main battery is either absent or discharged and no external power is supplied. The data maintained includes the user's configuration choices, and the system time and date.

Data Card

The Data Card allows the capture of key information such as ECG waveform, shock advisories, charging, and delivering a shock. The Data Card is read by the Code Runner Web system for post-event analysis.

CAUTION

The Data Card must be inserted or removed ***only*** when the unit is powered off. A Data Card inserted while the power is on will not be recognized by the unit. If a Card is removed while the power is on, its stored data may be corrupted and rendered unreadable.

7 Specifications

Overview

This section provides:

- Specifications for the M4735A,
- Symbol Definitions for symbols appearing on the M4735A,
- Safety related information, and
- Electromagnetic compatibility information.

Specifications

Defibrillator

Waveform: Biphasic Truncated Exponential. Waveform parameters adjusted as a function of patient impedance.

For details of waveforms delivered, see the "Waveforms" section of this chapter.

Shock Delivery: Via multifunction defib electrode pads, or paddles.

Delivered Energy Accuracy: See Table 7-1.

Table 7-1 Delivered Energy (J) vs. Load Impedance

Selected Energy (J)	Load Impedance (ohms)					Accuracy
	25	50	100	125	150	
2	1.9	2.0	2.1	2.1	2.1	± 1 J
3	2.8	3.0	3.2	3.2	3.1	± 2 J
5	4.7	5.0	5.2	5.4	5.2	± 2 J
7	6.6	7.0	7.3	7.5	7.3	± 2 J
10	9.3	10.0	10.4	10.7	10.4	± 2 J
20	18.6	20.0	20.8	21.4	20.8	± 4 J
30	27.9	30.0	31.2	32.1	31.2	± 4 J
50	46.7	50.0	52.3	53.5	52.1	±15%
70	65.4	70.0	73.1	75.0	72.9	±15%
100	93.5	100.0	104.7	107.2	104.4	±15%
150	140.3	150.0	156.8	161.0	156.5	±15%
200	187.0	200.0	209.3	214.6	208.6	±15%

Charge Time: Less than 3 seconds to 200 Joules with a new, fully charged M3516A SLA battery pack at 25^{o}C. Less than 15 seconds to 200 Joules when powered by AC with no battery installed.

Patient Impedance Range: 25 to 180 Ohms.

Manual Mode

Manual Output Energy (Delivered): 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200 Joules.

Controls: Manual/AED On/Energy Select knob, Charge/Disarm, Shock, ECG Lead Select, SpO_2 On/Off, SpO_2 Alarms, HR Alarms, Sync On/Off, Pacer, Pacer Start/Stop, Pacer Rate, Pacer Current, Pacer Mode, ECG Gain, Volume, Strip, Summary, Mark.

Indicators: EL display for ECG waveform and text prompts, Audio alerts, QRS Beeper, Charging Tones (for sync and asynchronous modes), AC Power LED, Battery Charging LED, Sync LED, Pacer LED.

Armed Indicators: Charge done tone and available energy indicated on display.

Energy Selection: Front panel rotary knob.

Charge Control: Front Panel “2” key or button on paddles.

Shock Control: Front Panel "3" key or buttons on paddles.

Synchronizer: SYNC message appears on the monitor and is annotated on the printer (if printing while in Sync Mode). An audible beep sounds with each detected R-wave, while a tick mark on the monitor and printed strip indicate the discharge points. Synchronizer delay is less than 60 msec from peak of R-wave to peak current of the defibrillation discharge.

AED Mode

AED Energy Profile: Fixed Energy (150 Joules).

AED Shock Series: 1, 2, 3, or 4 shocks per series.

Shock Series Timer: off, 30, 60, 90, 120, 150, 180, or 210 seconds.

Text and Voice Prompts: Extensive text and audible messages guide user through protocol.

AED Controls: On, Off, Pause/Resume, Analyze/Stop Analysis, Shock, Lead Select, SpO_2 On/Off, SpO_2 Alarms, HR Alarms, ECG Gain, Volume, Strip, Summary, Mark.

Indicators: EL display for ECG waveform and text prompts, Audio alerts, Voice prompts, QRS Beeper, Charging Tone, Charge Done Tone, Printer, AC Power LED, Battery Charging LED.

Armed Indicators: Charge Done Tone, Available Energy indicated on display, Voice Message.

Patient Analysis: Per protocol, evaluates patient ECG and signal quality to determine if a shock is appropriate and evaluates connection impedance for proper defibrillation pad contact.

Shockable Rhythms: Ventricular fibrillation with amplitude > 100 uV and wide complex ventricular tachycardia with rates greater than 150 bpm.

Sensitivity and Specificity: Meets AAMI guidelines.

ECG Monitoring

Inputs: Single channel ECG may be viewed on display and printed. Pads ECG is obtained through two multifunction defibrillation electrode pads. Lead I, II, or III are obtained through the 3-lead ECG cable and separate monitoring electrodes. With a 5-lead cable, leads aVR, aVL, aVF, and any one of the V (1-6) leads can also be obtained.

Lead Fault: LEADS OFF message and dashed line appear on the display if an electrode or lead wire becomes disconnected while a lead is selected.

Paddle Fault: NO PADDLES CONNECTED message and dashed line appear on the display in Manual Mode if paddles become disconnected.

Pad Fault: PADS OFF message and dashed line appear on the display if a pad becomes disconnected.

Heart Rate Display: Digital readout on display from 15 to 300 bpm, with an accuracy of ±10%.

Heart Rate Alarms: Configurable pairs of low and high heart rate alarm limits: 30 to 100, 60 to 140, 90 to 160, and 120 to 200 bpm.

Hands Free Defibrillation Patient Cable Length: 7 ft. (2.13 m).

ECG Cable Length: 12 ft. (3.7 m).

Common Mode Rejection: Greater than 90 dB measured per AAMI standard for cardiac monitors (EC 13).

ECG Size: 2.5, 5, 10, 20, 40 mm/mV.

Frequency Response:

AC Line Filter: 60 Hz/50Hz.

Pads ECG for Display: Monitor (.15-40 Hz) or EMS (1-30 Hz).

Pads ECG for Printer: Monitor (.15-40 Hz) or EMS 1-30 Hz).

Leads ECG for Display: Monitor (.15-40 Hz) or EMS (1-30 Hz).

Leads ECG for Printer: Diagnostic (.05-150 Hz) or EMS (1-30 Hz) or Monitor (.15-40 Hz).

Patient Isolation (defibrillation proof):

ECG: Type CF

SpO_2: Type CF

Defib: Type BF - External paddles/pads
Type CF - Internal paddles

NOTE

The HeartStart XL supports two types of Displays, EL or LCD. See "Identifying the Display Type" on page 5-7 for information.

Display (EL)

Size: 115 mm x 86 mm.

Type: EL - Electroluminescent.

Resolution: 320 x 240 pixels.

Sweep Speed: 25 mm/s nominal (stationary trace; sweeping erase bar).

Viewing Time: 4 seconds.

Display (LCD)

Size: 111.4 mm x 83.5 mm.

Type: LCD - TFT Color Liquid Crystal Display

Resolution: 320 x 240 pixels.

Sweep Speed: 25 mm/s nominal (stationary trace; sweeping erase bar).

Viewing Time: 4 seconds.

Battery

Type: 2 Ah, 12V, rechargeable, Sealed Lead Acid (SLA).

Dimensions: 2.4" (H) x 0.94" (W) x 7.2" (D).
61.7 mm (H) x 23.9 mm (W) x 182 mm (D).

Weight: 1.4 lb. (0.65 kg).

Charge Time:

- Approximately 3 hours to 90% charge, indicated by LED on front panel.
- Approximately 15 hours total to 100%.

Capacity: With a new, fully charged battery at room temperature (25^{o}C):

- >100 minutes ECG monitoring only, or
- 50 full-energy (200 J) discharges, or
- 75 minutes ECG monitoring while pacing (100 mA, 100 ppm).

Battery Indicators: LOW BATTERY message appears on display when at least 10 minutes of monitoring time and 5 maximum-energy discharges remain (with a new battery at room temperature - 25^{o}C).

Battery Storage: Should not be stored above 40^{o}C for extended periods of time.

Unit can be operated using only AC power, with no battery installed.

Thermal Array Printer

Continuous Real Time Strip: User starts and stops the strip. The Print Strip prints the selected ECG lead with the following data:

HEADER 1: Date, Time, Heart Rate, the SpO_2 Value (if available), and the text “Delayed” if printing has been configured for Delayed Mode. Prints every 12 seconds.

HEADER 2: Current mode (AED/Manual), Lead, Gain, filter setting, the text “Sync” (if Sync has been enabled), and Pacer Settings (consisting of the Pacer Mode, Rate, and Current, if currently pacing the patient). Prints every 12 seconds, with Header 1.

HEADER 3: Changes in Mode, Gain, Lead, Sync, and Pacer Settings.

FOOTER: Drug Annotations, HR/SpO_2 limits on a Limit Alarm, the Results of Analysis in AED Mode (No Shock Advised, Shock Advised, or Cannot Analyze), Charging to xxxJ, Shock Delivered, No Shock Delivered, Disarm, Battery Low.

SYMBOLS: Mark Triangle (for presses of the Mark key), an Alarm Bell (Alarm Limit Violations), Lightning Bolt (Shock Delivered; followed by b for biphasic), Vertical stripe Boundaries/Pacer/Sync Tick Marks.

Event Printing: Mark key automatically documents ECG and events during defibrillation episodes. The Mark key can annotate the event with one of the following labels: Epinephrine (Adrenaline), Atropine, Lidocaine, and Other.

Auto Printing: The printer can be configured to automatically print on Mark, Charge, Shock and Alarm.

Delayed Printing: The printer can be configured to run real time or with a six second delay.

Reports: The following can be printed: Event Summary, Configuration, Extended Self Test, System Log, Battery Capacity Test, Shift/System Check.

Speed: 25 mm/s with an accuracy of ±5%.

Amplitude Accuracy: ±10% or ±50 uV, whichever is greater.

Paper Size: 50 mm by 30 m (100 ft.).

Noninvasive Pacing

Waveform: Monophasic Truncated Exponential.

Current Pulse Amplitude:

Range: 10 mA to 200 mA (5 mA resolution)

Accuracy: 10 mA - 50 mA ±5 mA

50 mA - 200 mA ±10%.

Pulse Width: 20 ms with accuracy +0, -5 ms.

Rate: 30 ppm to 180 ppm (10 ppm increments); accuracy ±1.5%.

Modes: Demand or Fixed Rate.

Refractory Period: ≤ 80 ppm: 340 msec ±10%
> 80 ppm: 240 msec ±10%

SpO_2 Pulse Oximetry

Range:

SpO_2 - 0 to 100%.

Pulse Rate - 30 to 300 bpm.

Accuracy with:

M1191A sensor - 1 standard deviation 70% to 100%, ± 2.5%

M1192A sensor - 1 standard deviation 70% to 100%, ± 2.5%

M1194A sensor - 1 standard deviation 70% to 100%, ± 4.0%

M1131A sensor - 1 standard deviation 70% to 100%, ± 3.0%

M1903B sensor - 1 standard deviation 70% to 100%, ± 3.0%

M1904B sensor - 1 standard deviation 70% to 100%, ± 3.0%

Pulse Rate Accuracy: 2% or 1 bpm (whichever is greater).

Wavelength Range: 500 to 1000 nm.

Emitted Light Energy: ≤ to 15 mW.

Display Update Interval: ≤ 60 seconds.

Resolution: 1%.

$Sp0_2$ Alarm Limits: Three preset low alarm limits: 90%, 85%, and 80%.

INOP Alerts: Triggered by disconnected sensor, noisy signal, light interference or low signal (non-pulsatile).

Alarm delay: ≤ 10 seconds.

Event Storage

Internal Event Summary:

The internal Event Summary stores up to 300 events and up to 50 waveforms.

Events can be marked with a Mark symbol and, if configured for drug annotation, the following labels can be added: Epinephrine (Adrenaline in U.K. and Australia), Atropine, Lidocaine, or Other.

The Summary key on the front panel is used to print the internal Event Summary.

Data Card Event Summary:

The Data Card stores continuous ECG waveforms and events.

General

Dimensions: 19.0 cm (H) x 37.6 cm (W) x 34.6 cm (L)
7.5" x 14.8" x 13.7"

Weight: Standard Configuration weighs 6.5 kg (14.3 lbs.) including battery, full roll of paper, and external paddles.

Environmental

Temperature: 0^{o} to 55^{o}C operating, -20^{o} to 70^{o}C storage.

- Thermal paper may darken above 55^{o}C.
- Charging the battery at temperatures above 35oC may degrade battery life.
- Storing the battery for extended periods at temperatures above 40oC will reduce battery capacity and degrade battery life.

Humidity: Up to 95% Relative Humidity.

- Printer may jam if paper is wet.
- Printer may be damaged if wet paper is allowed to dry while in contact with the printhead elements.

Altitude: Operating: up to 15,000 ft. Storage: up to 15,000 ft.

Shock: Philips Medical Systems Section 760, Class B1 Drop Test.

Vibration: Philips Medical Systems Corp. Section 759 Class B1 Vibration.

Water Resistance: Meets IEC 601-2-4 (44.3),
IEC 529 Level IPX0 (non-protected).

Safety: Meets EN 60601-1

EMC: Meets EN 60601-1-2.

Other Considerations: Equipment not suitable for use in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

Mode of Operation: Continuous.

AC Line Powered: 100-240 VAC, 50/60 Hz, .4A max (unit off),
1.5A max (while charging defibrillator).

Battery Powered: 12 V Rechargeable, SLA.

Waveforms

Figure 7-1 150J 25 Ohms Biphasic Waveform

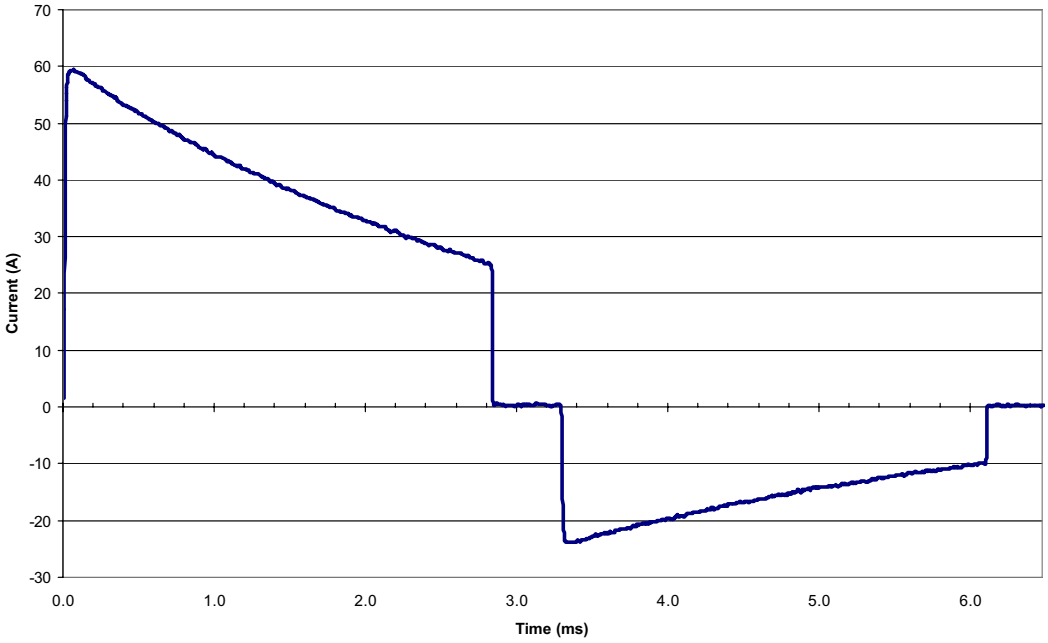


Figure 7-2 150J 50 Ohms Biphasic Waveform

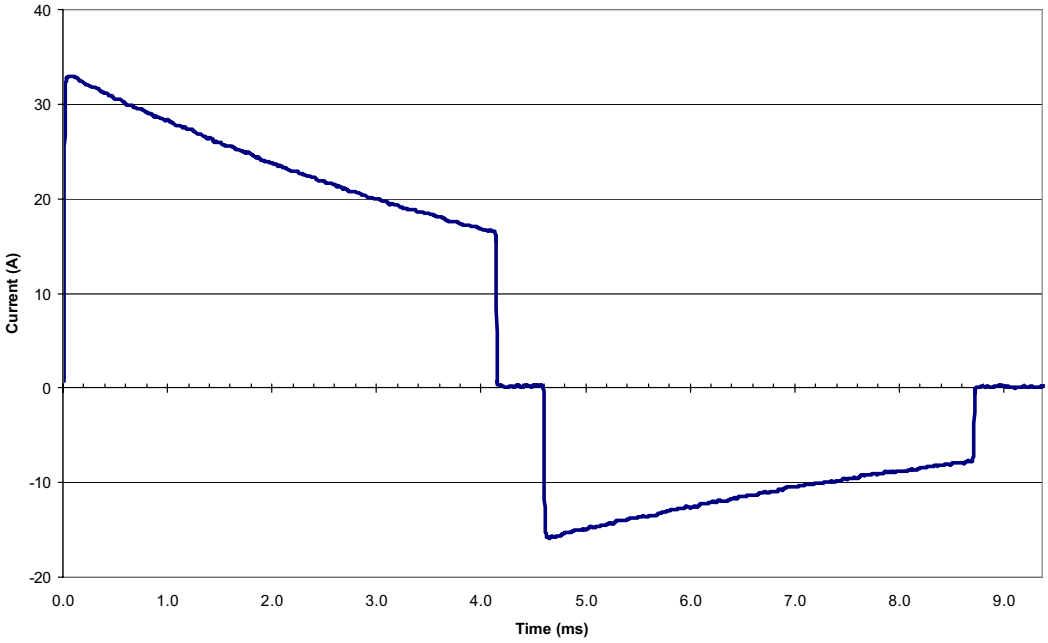


Figure 7-3 150J 75 Ohms Biphasic Waveform

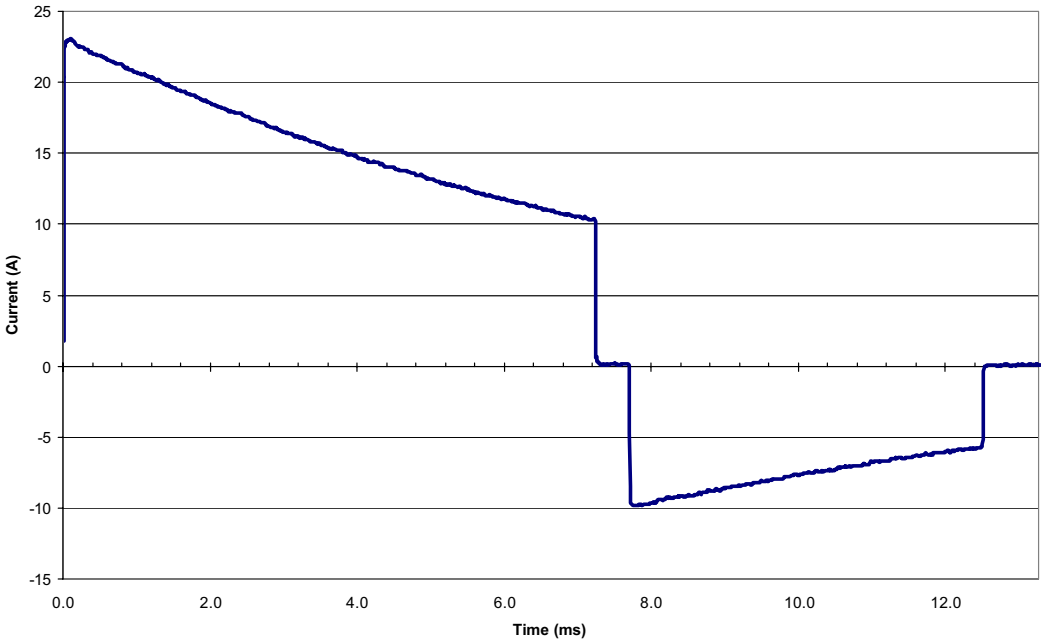


Figure 7-4 150J 100 Ohms Biphasic Waveform

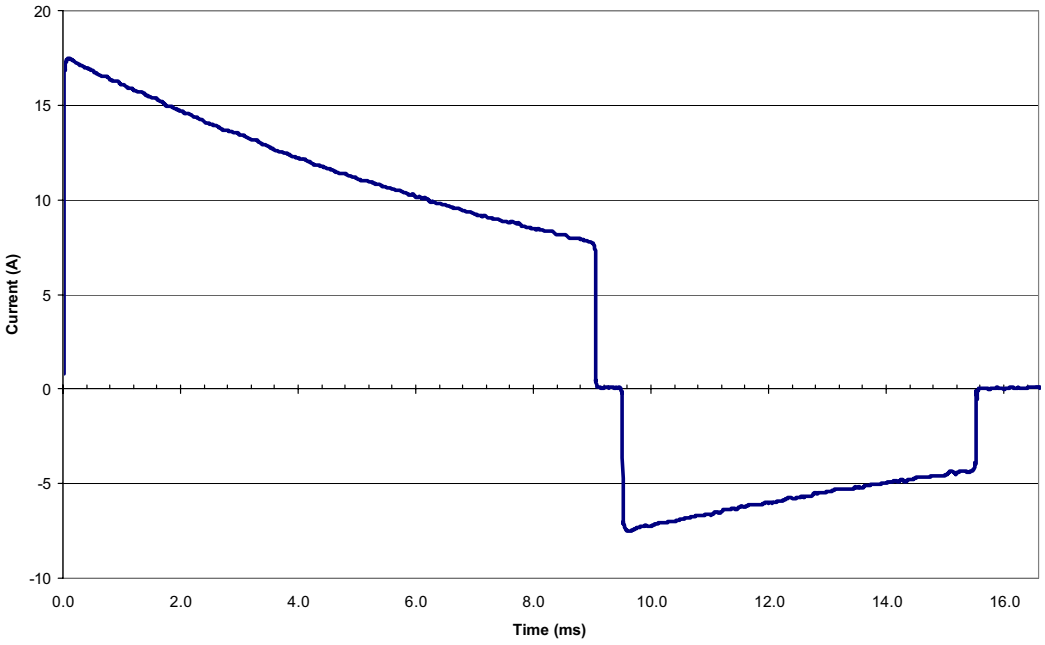


Figure 7-5 150J 125 Ohms Biphasic Waveform

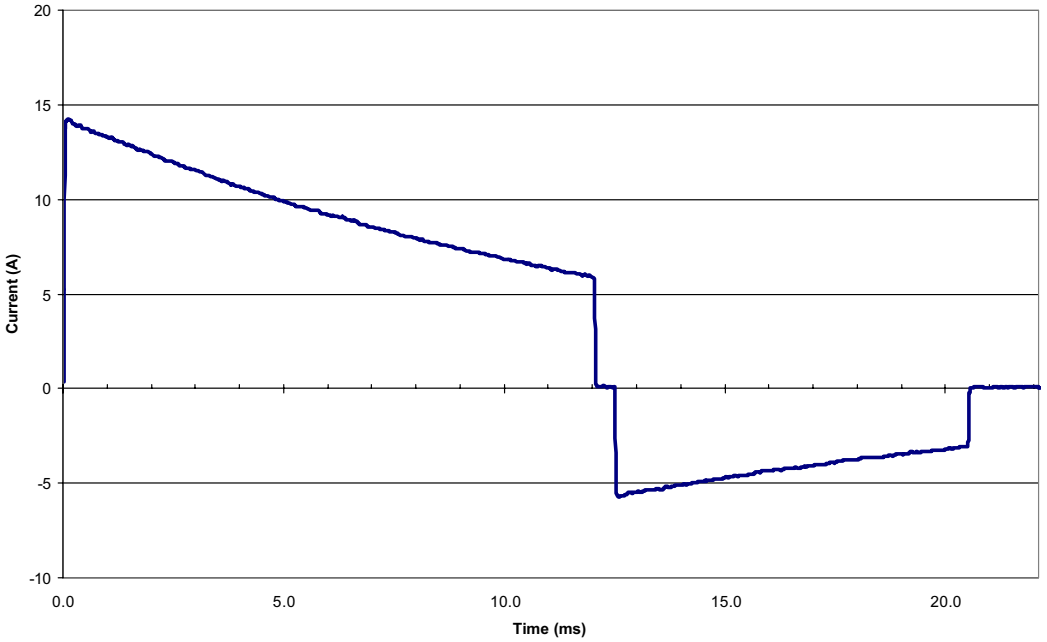


Figure 7-6 150J 150 Ohms Biphasic Waveform

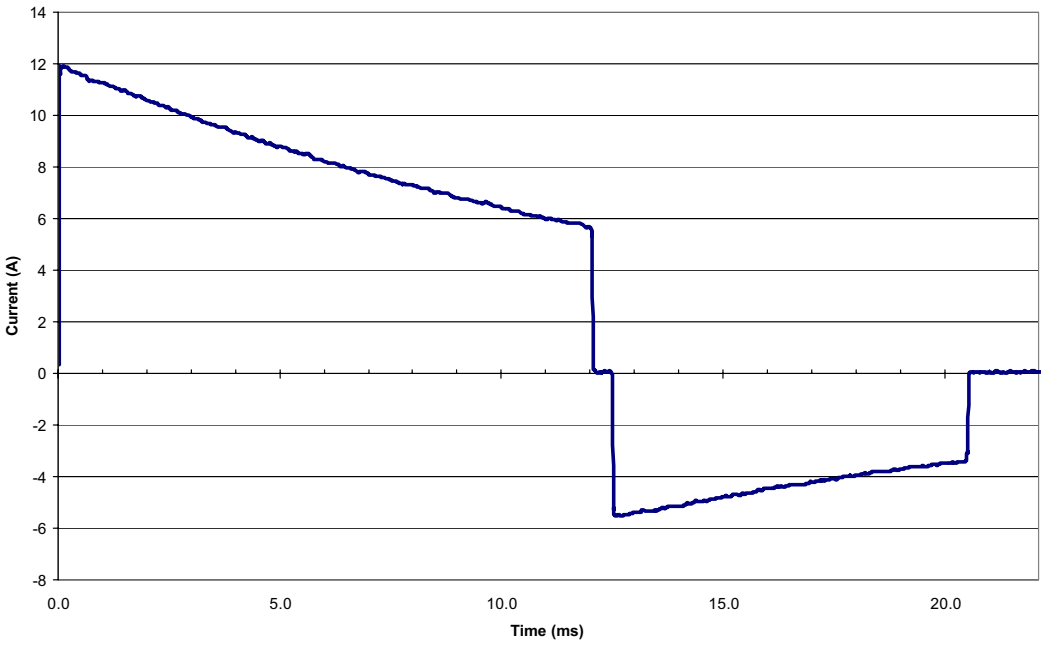


Figure 7-7 150J 175 Ohms Biphasic Waveform

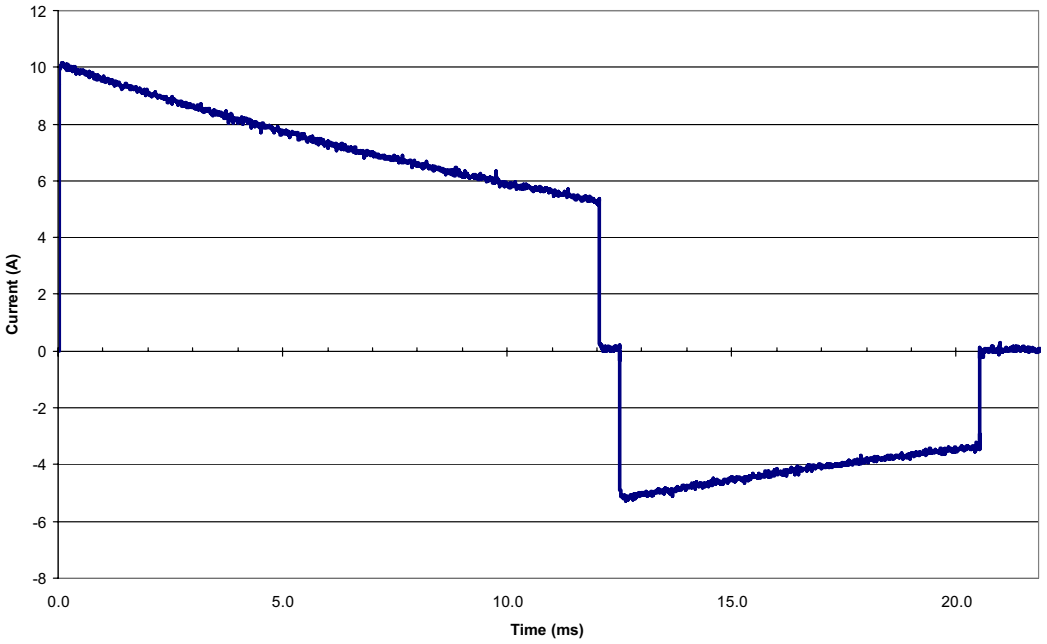


Figure 7-8 200J 25 Ohms Biphasic Waveform

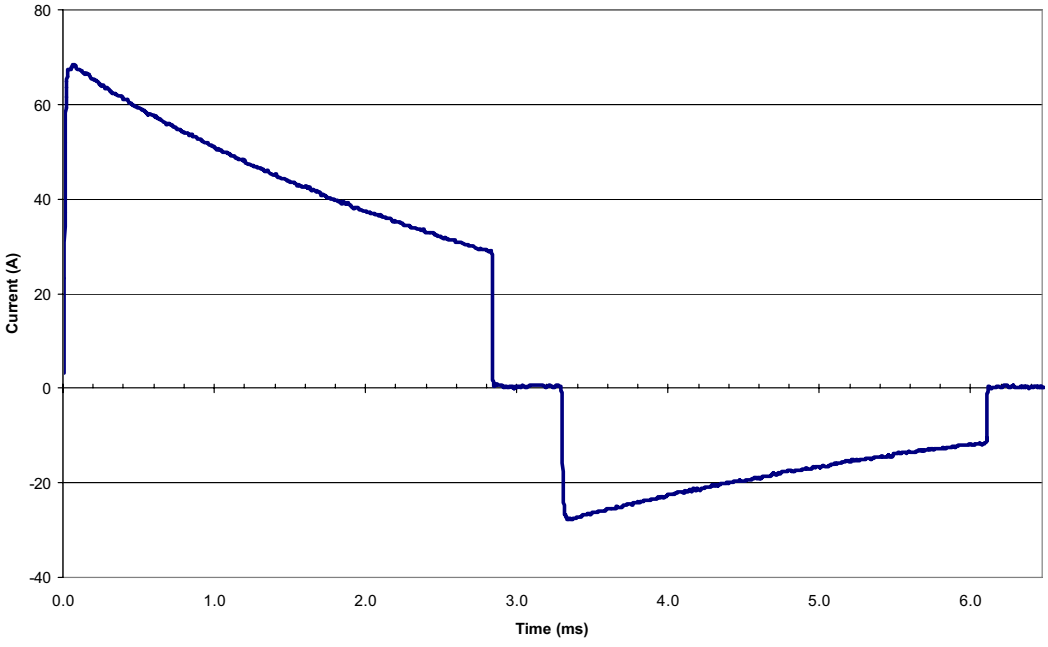


Figure 7-9 200J 50 Ohms Biphasic Waveform

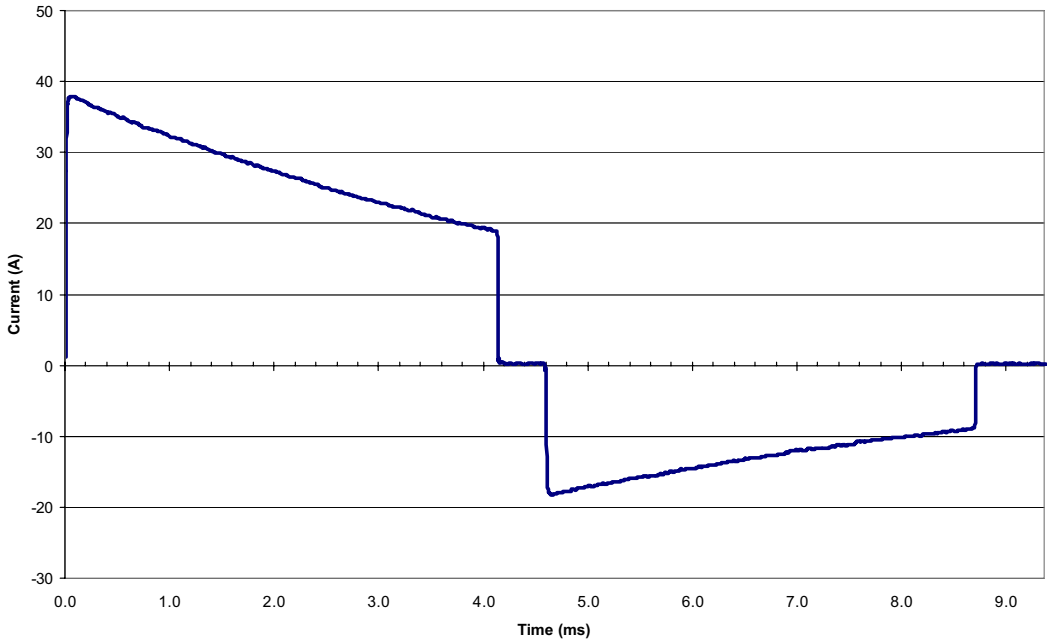


Figure 7-10 200J 75 Ohms Biphasic Waveform

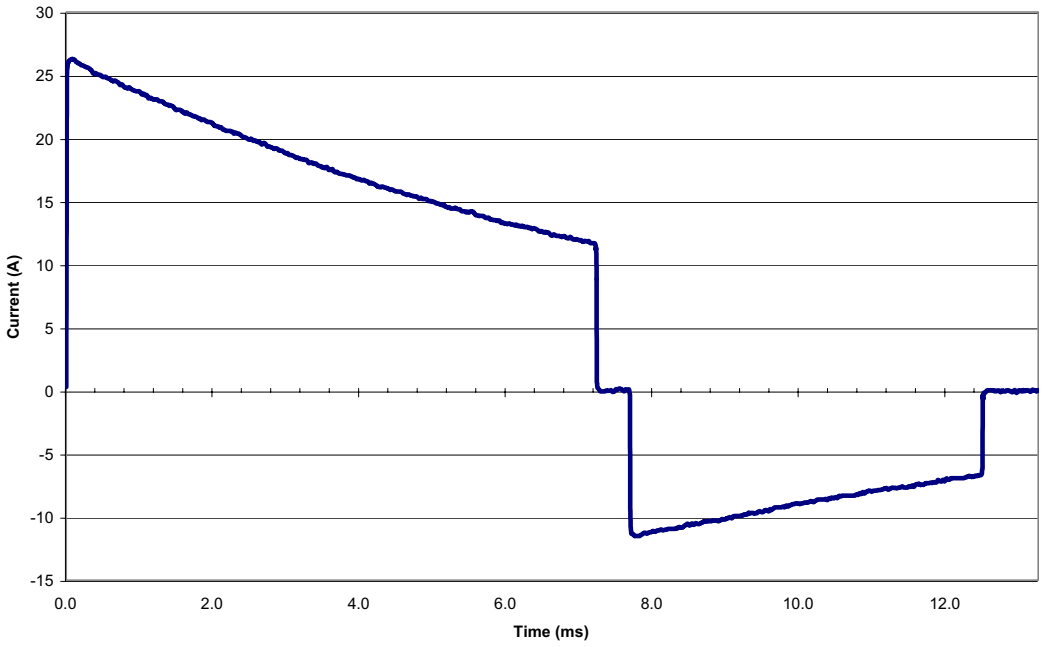


Figure 7-11 200J 100 Ohms Biphasic Waveform

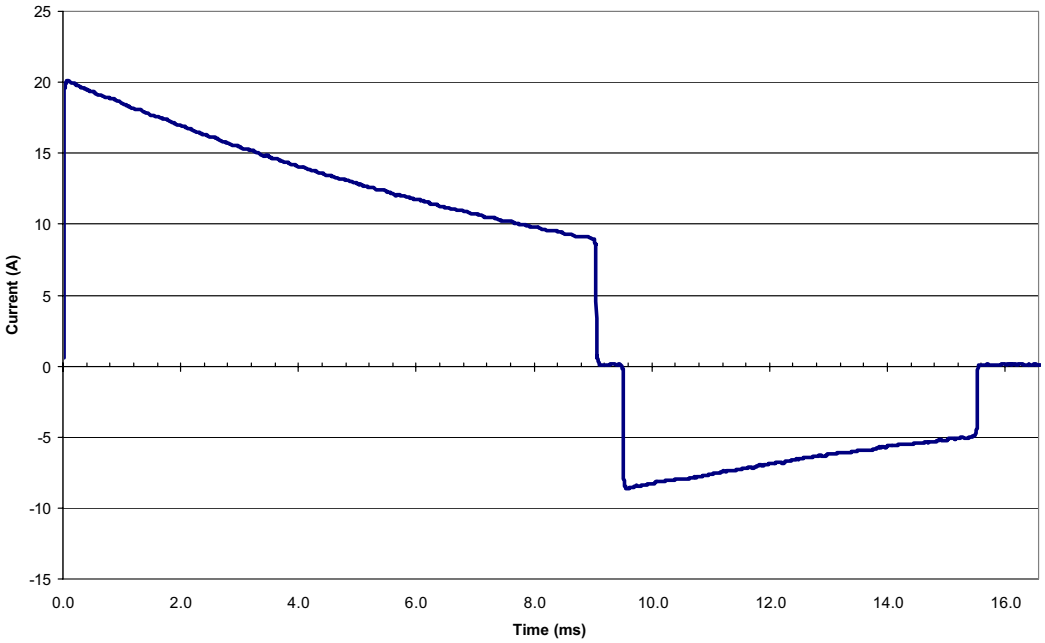


Figure 7-12 200J 125 Ohms Biphasic Waveform

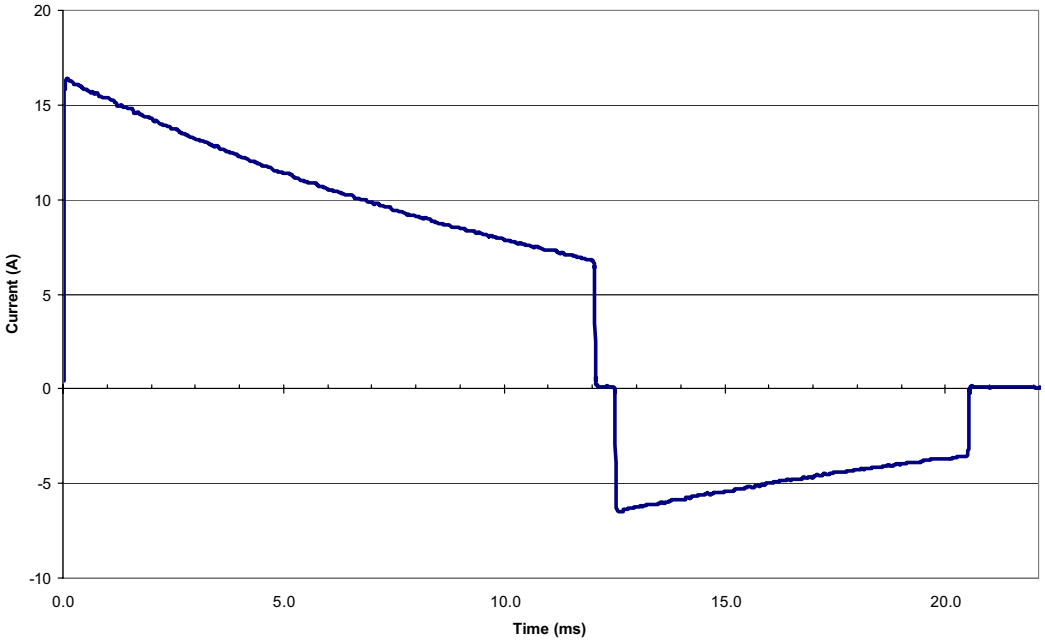


Figure 7-13 200J 150 Ohms Biphasic Waveform

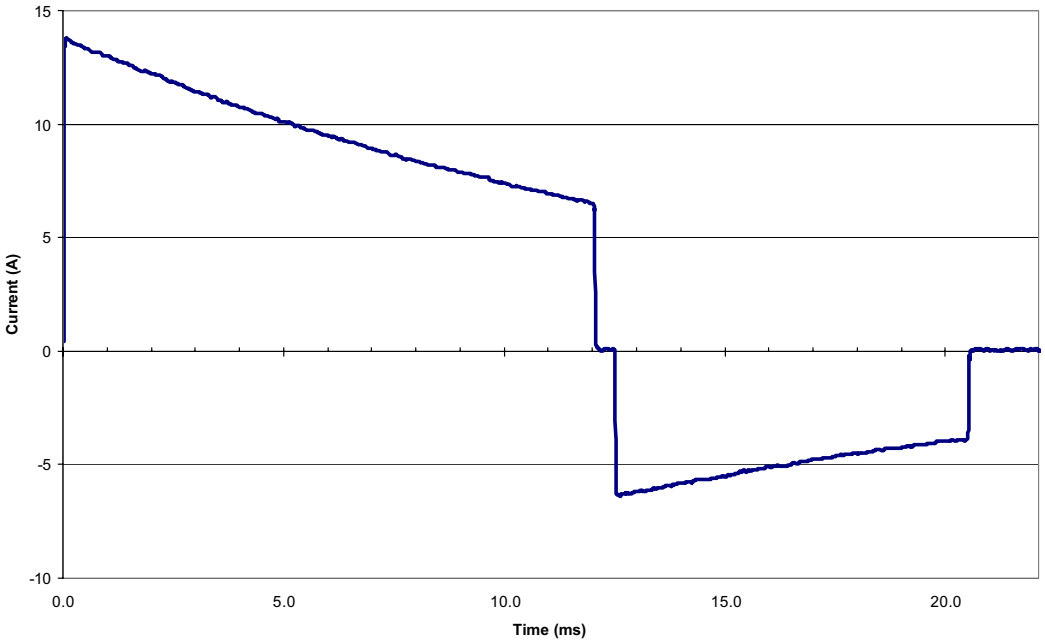
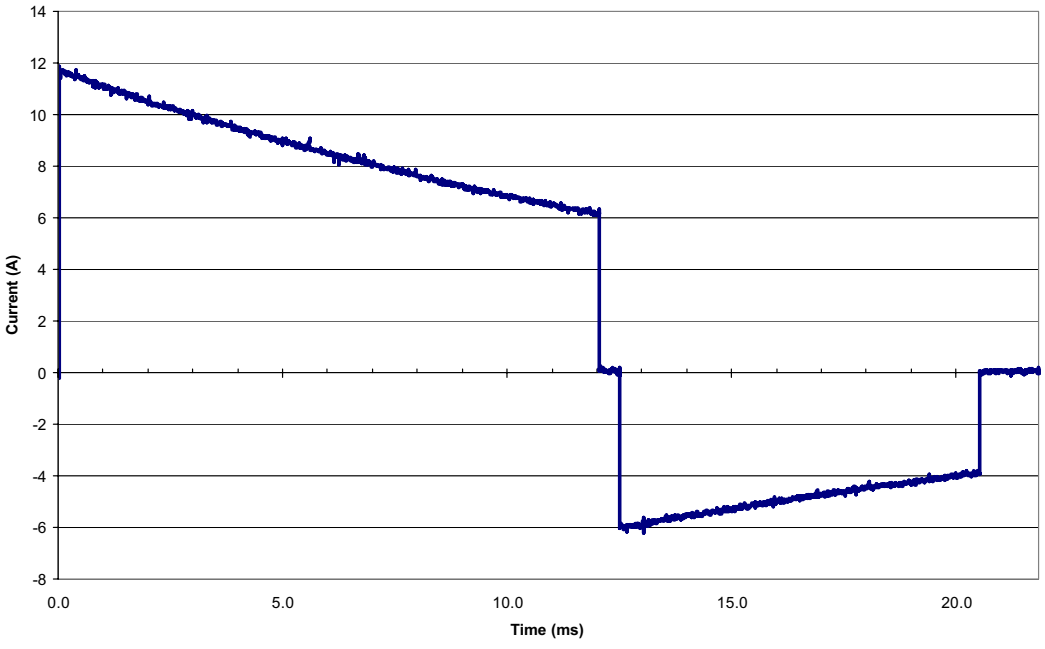


Figure 7-14 200J 175 Ohms Biphasic Waveform



Symbol Definitions

The following table lists the meanings of each symbols shown on the M4735A and the M3516A battery:

Table 7-3 Defibrillator and Battery Symbols

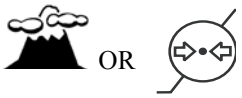
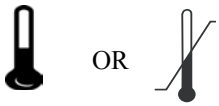
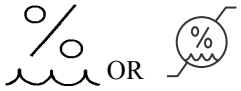
Symbol	Definition
	Shock hazard.
	Caution - See operating instructions in ***Instructions for Use***.
	Input
	Meets IEC type BF leakage current requirements and is defibrillator protected (Patient Applied Part is isolated and defib-proof suitable for direct patient contact except the heart or major arteries.)
	Meets IEC type CF leakage current requirements and is defibrillator protected (Patient Applied Part is isolated and defib-proof suitable for direct patient contact including the heart and major arteries).
	Alarms are active.
	Alarms are inactive.
	Recyclable material.
	Must be recycled or disposed of properly.
	Unlock.
	Audio speaker.
	Protective earth ground.
	Alternating current

Table 7-3 Defibrillator and Battery Symbols

Symbol	Definition
	Dangerous Voltage
	Biphasic energy is being used.

The following table lists the symbols that may appear on the M4735A shipping carton:

Table 7-4 Shipping Carton Symbols

Symbol	Definition
	Atmospheric pressure range.
	Temperature range.
	Relative humidity range.
	Recyclable paper product.
	Fragile.
	Right side up.
	Do not get wet.
	Shelf life.
	Long-term storage conditions.
	Short-term transport storage.

Safety Considerations

The following general warnings and cautions apply to use of the HeartStart XL. Additional warning and cautions specific to a particular feature are provided in the appropriate section.

WARNING **The HeartStart XL is not intended to be deployed in settings or situations that promote use by untrained personnel. Operation by untrained personnel can result in injury or death.**

WARNING **Remain attentive to the patient during the delivery of therapy. Delay in delivering a shock may result in a rhythm that was analyzed as shockable converting spontaneously to non-shockable and could result in inappropriate delivery of a shock.**

WARNING **Use only the multifunction defib electrode pads, battery, and accessories listed in Table 5-17. Substitutions may cause the HeartStart XL to function improperly.**

WARNING **Use multifunction defib electrode pads prior to their expiration date. Discard pads after use. Do not reuse pads. Do not use for more than 8 hours of continuous pacing.**

WARNING **In AED Mode, the multifunction defib electrode pads must be in the anterior-anterior position as shown on the packaging. The HeartStart XL was not designed to assess data acquired from pads in an anterior-posterior position.**

WARNING **Use only 3-wire AC power cords with 3-pronged grounded plugs.**

WARNING **Keep hands and feet clear of paddle electrode edges. Use your thumbs to depress the shock buttons on the paddle handle.**

CAUTION Conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact other conductive parts including earth.

WARNING **Do not allow multifunction defib electrode pads to touch each other or to touch other ECG monitoring electrodes, lead wires, dressings, etc. Contact with metal objects may cause electrical arcing and patient skin burns during defibrillation and may divert current away from the heart.**

WARNING	**During defibrillation, air pockets between the skin and multifunction defib electrode pads may cause patient skin burns. To help prevent air pockets, make sure the pads completely adhere to the skin. Do not use dried out pads; do not open pads package until just prior to use.**
WARNING	**Never touch the patient or any equipment connected to the patient (including the bed or gurney) during defibrillation.**
WARNING	**Never operate the HeartStart XL in standing water.**
WARNING	**Do not immerse, or pour fluids on, any portion of the HeartStart XL.**
WARNING	**Do not use the HeartStart XL in a flammable or oxygen-rich atmosphere. This can cause an explosion hazard.**
WARNING	**Avoid connecting the patient to several devices at once. Leakage current limits may be exceeded. Do not use a second defibrillator on the patient while pacing with the HeartStart XL.**
NOTE	The HeartStart XL can be operated with only AC line power, only 12v M3516A SLA Battery or AC power and M3516A SLA battery simultaneously.
WARNING	**Avoid contact between the patient and conductive fluids and/or metal objects, such as the gurney. Contact with metal objects could cause unintentional current pathways.**
WARNING	**Operating the HeartStart XL or its accessories in conditions outside the environmental specifications can result in device or accessory malfunction.**
WARNING	**Medical electrical equipment which does not incorporate defibrillator protection should be disconnected during defibrillation.**
WARNING	**Electric shock hazards exist internally. Do not remove assembly screws. Refer servicing to qualified personnel.**

CAUTION	This device has not been evaluated for use with electrosurgery equipment.
NOTE	This device and accessories are not intended for home use.
CAUTION	Do not discharge the defibrillator with the paddles shorted together.
WARNING	**Properly dispose of or recycle depleted batteries according to local regulations. Do not puncture, disassemble, or incinerate batteries.**
WARNING	**Where the integrity of the external protective earth conductor is in doubt, the device shall be operated from its internal power source.**
NOTE	For operation in the U.S., the attachment plug must be the proper NEMA type for connection to the alternative voltage.
CAUTION	Be aware of patient cables, including ECG monitoring equipment when used with high frequency surgical equipment.
NOTE	If software upgrades were done as part of the repair process, point the customer to the Philips Documents and Downloads web site (www.medical.philips.com/goto/productdocumentation) for the latest versions of the HeartStart XL *Instructions for Use* and other documentation.

Electromagnetic Compatibility

When using the M4735A HeartStart XL Defibrillator/Monitor, electromagnetic compatibility with surrounding devices should be assessed.

A medical device can either generate or receive electromagnetic interference. Testing for electromagnetic compatibility EMC with and without the appropriate accessories has been performed according to the international standard for EMC for medical devices (IEC 60601-1-2). This IEC standard has been adopted in Europe as the European Norm (EN 60601-1-2).

The EMC standards describe tests for both emitted and received interference. Emission tests deal with interference generated by the device being tested.

WARNING

Radio frequency (RF) interference from nearby transmitting devices may degrade performance of the M4735A HeartStart XL Defibrillator/Monitor. Electromagnetic compatibility with surrounding devices should be assessed prior to using the defibrillator.

Reducing Electromagnetic Interference

The M4735A HeartStart XL Defibrillator/Monitor and associated accessories may be susceptible to interference from other RF energy sources and continuous, repetitive, power line bursts. Examples of other sources of RF interference are medical devices, cellular products, information technology equipment and radio/television transmission. Should interference be encountered, as demonstrated by artifact on the ECG or dramatic variations in SpO_2 values, attempt to locate the source. Assess:

- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical devices?
- Does the SpO_2 value change dramatically when the AC line cord is unplugged?

Once the source is located, attempt to attenuate the EMC coupling path by distancing the defibrillator from the source as much as possible. If assistance is needed, call your local service representative.

Restrictions for Use

Artifact on the ECG caused by electromagnetic interference should be evaluated by a physician or physician authorized personnel to determine if it will negatively impact patient diagnosis or treatment.

Immunity Level (Devices with Serial Numbers US001XXXXX)

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. It is recognized that the HeartStart XL defibrillator/monitor is designed to receive and amplify low level signals in the same bandwidth as the interference.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in ECG quality is a qualitative assessment which can be subjective.

Caution should, therefore, be taken in comparing immunity levels of different devices. The criteria used for degradation is not specified by the standard and may vary with the manufacturer.

Emissions and Immunity (Devices with Serial Numbers US002XXXXX or greater)

The HeartStart XL is designed and tested to comply with the radiated and conducted emissions requirement of EN 60601-1-2:2002. See Tables 7-5 through 7-9 for detailed information regarding declaration and guidance.

WARNING

The use of accessories, transducers and cables other than those specified below may result in increased emissions or decreased immunity of the HeartStart XL.

Fixed, portable, and mobile frequency communications equipment can affect the performance of medical equipment. See Table 7-9 for the minimum recommended separation distance between RF communications equipment and the HeartStart XL.

The list of cables, transducers, and other accessories with which Philips claims compliance with the emissions and immunity requirements of EN 60601-1-2 are listed in Chapter 5.

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in ECG quality is a qualitative assessment which can be subjective.

Caution should, therefore, be taken in comparing immunity levels of different devices. The criteria used for degradation is not specified by the standard and may vary with the manufacturer.

Guidance and Manufacturer's Declaration (Devices with Serial Numbers US002XXXXX or greater)

The HeartStart XL is intended for use in the electromagnetic environment specified in the tables below. The customer or the user of the HeartStart XL should assure that it is used in such an environment.

Table 7-5: Electromagnetic Emissions

Emissions Test	Compliance	Electromagnetic Environment - Guidance
RF emissions CISPR 11	Group 1	The HeartStart XL uses RF energy only for its internal function. Therefore, its RF emissions are very low and not likely to cause interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The HeartStart XL is suitable for use in all establishments, including domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	

Table 7-6: Electromagnetic Immunity - General

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ±1 kV for input/output lines	± 2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	< 5% U_T[a] (> 95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	< 5% U_T[a] (> 95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the HeartStart XL requires continued operation during power mains interruptions, it is recommended that the HeartStart XL be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
[a]U_T is the AC mains voltage prior to application of the test level.			

Table 7-7: Electromagnetic Immunity - Life Supporting Functions

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the HeartStart XL, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands[a]	3 Vrms	Recommended Separation Distance $d = 1.2\sqrt{P}$
	10 Vrms 150 kHz to 80 MHz in ISM bands[a]	10 Vrms	Recommended Separation Distance $d = 1.2\sqrt{P}$

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Radiated RF IEC 61000-4-3	10 V/m 80 MHz to 2.5 GHz	10 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter's specified output power and *d* is the recommended separation distance in meters (m).[b] Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[c] should be less than the compliance level in each frequency range.[d] Interference may occur in the vicinity of equipment marked with the following symbol: 

At 80 MHz and 800 MHz, the higher frequency range applies.
These guidelines my not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz and 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

[b] The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

[c] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the HeartStart XL is used exceeds the applicable RF compliance level above, the HeartStart XL should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the HeartStart XL.

[d] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Table 7-8: Electromagnetic Immunity - Nonlife Supporting Functions

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the HeartStart XL, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	**Recommended Separation Distance** $d = 1.2\sqrt{P}$

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter's specified output power and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 
At 80 MHz and 800 MHz, the higher frequency range applies. These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the HeartStart XL is used exceeds the applicable RF compliance level above, the HeartStart XL should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the HeartSTart XL.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances

The HeartStart XL is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the HeartStart XL can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the HeartStart XL as recommended below, according to the maximum output power of the communications equipment.

Table 7-9: Recommended Separation Distances

	Separation Distance According to Frequency of Transmitter (m)	
Rated Maximum Output Power of Transmitter (W)	**150 kHZ to 800 MHz**	**800 MHz to 2.5 GHz** $d = 2.3\sqrt{P}$
0.01	0.1 m	0.2 m
0.1	0.4 m	0.7 m
1	1.2 m	2.3 m
10	4 m	7 m
100	12 m	23 m

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter's manufacturer.

At 80 MHz and 800 MHz, the higher frequency range applies.

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

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